ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE

Construction, Operations, and Maintenance Plans

ATTACHMENT G

Soil Survey

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Prepared for:

Dominion Transmission, Inc.
707 East Main Street
Richmond, VA 23219

ORDER 1 SOIL SURVEY
ATLANTIC COAST PIPELINE
MONONGAHELA NATIONAL FOREST, WV AND GEORGE WASHINGTON NATIONAL FOREST, VA

AUGUST 1, 2016

Prepared by:

RETTEW
Geosyntec consultants
engineers | scientists | innovators

Reviewed by:

The Nicholas Putnam Group
Landform Soils, LLC

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EXECUTIVE SUMMARY

An Order 1 Soil Survey (Survey) was performed by RETTEW Associates, Inc. between May 9 and June 22, 2016 along the available sections of the approximately 21.4-mile portion of the Rev-10 and Rev-11 reroute between MP 47 and MP 115 on the proposed Atlantic Coast Pipeline (ACP) route (Project). The Survey included approximately 5.2 miles of the Marlinton Ranger District in the Monongahela National Forest (MNF), and 15 miles in the Warm Springs and North River Districts in the George Washington National Forest (GWNF). Due to access restrictions associated with cultural resource clearance, a full Survey was not completed in an approximately 1.2 mile section of the alignment located near MP 155 and MP 156 in the GWNF Pedlar Ranger District.

The soil survey activities were conducted to be compliant with the requirements outlined in special use permit #GBR205003, dated April 22, 2015 for surveys in the MNF, and special use permit #GWP433201T, dated March 31, 2015 for surveys in the GWNF, both of which were issued by the U.S. Forest Service. These two permits were renewed as #MAR205001 dated April 11, 2016 and #GWP433202T dated April 11, 2016, as well as amendment #1 to SUP GWP433202T dated May 20, 2016. The Survey was conducted in accordance with the Project's Order 1 Soil Survey Protocols dated April 2016 and updated May 23, 2016 **(Supplemental Document A)**. The Survey was conducted by soil scientists whose qualifications and credentials were approved by the U.S. Forest Service.

The Survey was conducted in four phases including: 1) Desktop Study; 2) Preliminary Field Reconnaissance; 3) Soil Scientist Team Training; and 4) Field Investigation. Background information was obtained during the desktop study to help identify the prevalent soil-landscape relationships across the proposed pipeline route within the Project area. The background information was also used by the soil scientist team to identify preliminary test pit locations and develop strategies for conducting the Survey. Preliminary GIS-generated maps were prepared for planning and field use.

The Survey was initiated with a five day preliminary field reconnaissance investigation (reconnaissance investigation) conducted between May 9 and May 13, 2016. The reconnaissance investigation included oversight by Dr. John Galbraith of Landform Soils, LLC and the Nicholas Putnam Group (NPG) represented by Mr. Stephen Carpenter and Mr. Charles Delp. Following completion of the Preliminary Field Reconnaissance, the protocols were revised to include additional documentation as suggested by Dr. Galbraith and NPG, and to identify Mr. Daniel Fenstermacher, CPSS as the Soil Scientist Team Lead. The revised soil survey protocols were provided to the Forest Service on May 23, 2016. On June 1, 2016, the soil scientist field teams were provided classroom and field training led by the Soil Scientist Team Lead and supported by the Technical Advisor (Dr. John Galbraith) and NPG. The primary field effort of the Survey occurred over 15 days between June 2 and June 22, 2016. Dr. John Galbraith and NPG accompanied the soil survey team during portions of the Soil Survey conducted in both the MNF and the GWNF.

Mr. Thomas Bailey, with the U.S. Forest Service (GWNF) met with the soil scientist team and Dr. John Galbraith on June 8, 2016, and Mr. Kent Karricker, Dr. James Thompson and other representatives from the U.S. Forest Service (MNF) met with the soil scientist team, NPG, and Dr. John Galbraith on June 15, 2016 to observe the Survey procedures.

During the field investigation, boundaries were sketched on field maps and recorded by GPS with sub-meter accuracy to delineate soil units; boundaries were based on observations in soil test pits and transect points (shallow observations). Delineated soil units were assigned a seven component code (**Attachment 6**) that defined the delineated soil unit based on parent material, slope class, drainage class, diagnostic subsurface horizon, restrictive layer type, depth to restrictive layer, and family particle size class. The delineated soil maps have been provided in **Attachment 1.**

The total number of test pits completed during the reconnaissance investigation and the field investigation was 360, including 85 test pits in the MNF and 275 test pits in the GWNF. A total of 511 soil samples were collected in duplicate by horizon in 111 test pits. Forty-one (41) of those test pits, including 190 horizons, were selected for particle size analysis, nutrient analysis, and total and organic carbon contents. Results from these analyses are and are presented in **Attachments 7**, **8**, **9** and **10**.

A detailed summary of the field observations and laboratory data is presented in **Section 6.0** of the Report. A few of the key observations from the investigation are as follows:

- The Project route is primarily situated on ridgelines and is primarily comprised of residual soil material with the observation of bedrock.
- Restrictive layers were observed in 255 of the 360 test pits observed, with 248 lithic contacts and 7 soils containing fragipans or fragic properties.
- Colluvium is abundant, primarily occurring as relatively shallow deposits with a residual base.
- Evidence of slope failures or movements were observed in two potential slide areas, surface sloughing at a third location, and several bent or leaning trees at other locations.
- The nutrient analysis revealed that the soils are mildly acidic and nutrient levels are generally below optimum levels.
- The soils have a high potential for erodibility due to a high silt fraction, observed in field textures, and the abundance of steep slopes.

1.0 INTRODUCTION

An Order 1 Soil Survey (Survey) was performed by RETTEW Associates, Inc. between May 9 and June 22, 2016 along the available sections of the approximately 21.4-mile portion of the Rev-10 and Rev-11 reroute between MP 47 and MP 115 on the proposed Atlantic Coast Pipeline (ACP) route (Project). The Survey included approximately 5.2 miles of the route within the Marlinton Ranger District in the Monongahela National Forest (MNF), and 15 miles in the Warm Springs and North River Districts in the George Washington National Forest (GWNF). Due to access restrictions associated with cultural resource clearance, a full Survey was not completed in an approximately 1.2 mile section of the Rev-10 route located near MP 155 and MP 156 in the GWNF Pedlar Ranger District.

The purpose of the Order 1 Soil Survey was to provide more site-specific soil data for the proposed pipeline corridor to support construction of a 42-inch diameter pipeline. This Report presents a summary of the Survey data collection process and procedures, laboratory results, and soil mapping. The Soil Survey Protocols developed for the Project are provided as Supplemental Data (**Attachment A**).

2.0 ORDER 1 SOIL SURVEY PROTOCOL SUMMARY

The Survey activities were conducted in a manner compliant with the requirements outlined in special use permit #GBR205003, dated April 22, 2015 for surveys in the MNF, and special use permit #GWP433201T, dated March 31, 2015 for surveys in the GWNF, both of which were issued by the U.S. Forest Service. These two permits were renewed as #MAR205001 dated April 11, 2016 and #GWP433202T dated April 11, 2016, as well as amendment #1 to SUP GWP433202T dated May 20, 2016.

The Survey was conducted in accordance with the Project's Order 1 Soil Survey Protocols (Protocols) dated April 2016 (Revised: May 23, 2016 and June 30, 2016; **Supplemental Document A**). All fieldwork was conducted by professional soil scientists whose qualifications and credentials were approved by the U.S. Forest Service. Geosyntec Consultants (Geosyntec) personnel provided program management and field logistics support for the soil survey team.

3.0 SOIL SURVEY

The Survey was conducted in four phases: (1) Desktop Study, (2) Preliminary Field Reconnaissance, (3) Team Training, and (4) Field Investigation. This section outlines the objectives and accomplishments of each phase.

3.1 Desktop Study

The initial phase of the Survey consisted of a desktop study to help identify the prevalent soil-landscape relationships across the proposed pipeline route within the Project area, aid in the identification of test pit locations, and develop strategies for conducting the Survey. Available topographic maps, geologic maps, soil map unit boundaries contained in the Soil Survey Geographic Database (SSURGO), aerial photography, and other pertinent remotely- sensed data were reviewed as part of the desktop study.

Preliminary GIS-generated maps were developed that included topographic contours, SSURGO map units, the pipeline centerline, the limits of the 300-foot survey corridor, and available Forest Service boundaries. Preliminary proposed test pit locations were plotted at a 350-foot interval spacing along the pipeline center line for planning purposes and to assist in field locating test pits. Actual soil test pit locations were determined by the soil scientists in the field.

3.2 Preliminary Field Reconnaissance

Field activities for the Survey were initiated with a preliminary field reconnaissance (Recon) investigation conducted between May 9 and May 13, 2016. The Recon investigation included oversight by Dr. John Galbraith of Landform Soils, LLC, and Nicholas Putnam Group (NPG) represented by Mr. Stephen Carpenter and Mr. Charles Delp. The objectives of the Recon investigation included:

- Assess and refine Project logistics.
- Conduct test pits to observe and discuss soil-landscape relationships in various locations in the MNF and GWNF.
- Receive input from Dr. Galbraith and NPG personnel on the Project's Survey Protocols, test pit selection, soil and parent material resources and relationships, landscape analysis, indicator vegetation types, identification of potential habitat for sensitive species (e.g. red spruce), identification of important soil properties to document and sample, and identification of unique soil formations (e.g. pit and mound formations, sinkholes, landslides, and outcrops).
- Assess and refine the Project's Survey Protocols and documentation.
- Develop a draft soil mapping key to be used during the field investigation.
- Prepare training materials for the soil survey team.

Following the completion of the Recon investigation, the Project's Survey Protocols were revised to include additional documentation as suggested by Dr. Galbraith and NPG personnel, and to identify Mr. Daniel Fenstermacher, CPSS as the Soil Scientist Team Lead. The revised Protocols were provided to the Forest Service on May 23, 2016.

During the Recon investigation, a total of 29 test pits (Recon pits) were observed in the MNF (11 Recon pits) and GWNF (18 Recon pits). Recon pits are noted with an "R" prefix in the test pit ID and are identified on the maps in **Attachment 1.** An inventory of soil test pits and locations are provided in **Attachment 2** and copies of the Recon log sheets are included in **Attachment 3**.

3.3 Team Training

Prior to starting the field investigation, the soil scientists and field support teams were provided classroom and field training on June 1, 2016. The training was led by the Soil Scientist Team Lead and supported by the Technical Advisor (Dr. John Galbraith) and the NPG. The purpose of the training was to discuss soil-landscape observations from the Recon investigation, unique soil properties that may be encountered and their distribution across the landscape, provide guidance on soil profile description best practices to maintain consistency between soil scientists. The training included a review of the draft ACP Order 1 Soil Mapping Key and naming system, and discussed other pertinent information gathered during the Recon investigation including criteria for identifying the soil delineation boundaries and composition. During the field training, the field teams traveled to a portion of the Project in the GWNF to review and conduct soil test pit selection, excavation, soil classification, and mapping protocols. During the field training, five soil test pits and two transect points were conducted with delineation of soil units.

3.4 Field Investigation

The Survey field investigation occurred over the course of 15 days between June 2 and June 22, 2016. The Technical Advisor and NPG accompanied each of the soil scientists at various points during field investigation to help maintain consistency in preparation of the soil profile descriptions and delineation of soil boundaries in the MNF and the GWNF. Mr. Thomas Bailey, with the GWNF, met with the soil scientist team on June 8, 2016, and Mr. Kent Karricker, Dr. James Thompson, and other representatives from MNF met with the soil scientist team on June 15, 2016 to observe the Survey process.

The proposed 350-foot spaced soil test pit locations developed during the desktop study were for planning and guidance purposes only. The actual soil test pit locations were selected by the soil scientists based on field observations to adequately describe the soils across the landscapes. At least one soil test pit was conducted in proximity to a proposed test pit location. Additional test pits (identified with a letter in the test pit ID number, e.g. P-###A-Date-Time-Initials) were added where the increased soil observation density was warranted to adequately describe all of the soil types and landforms.

Initially, the Protocols identified the need for a total of 290 proposed test pit locations based on an approximate 350-foot spacing, with 80 soil test pits located in the MNF and 210 soil test pits located in the GWNF. A total of 360 soil test pits were completed to date during the Recon investigation and field investigation, with 85 located in the MNF and 275 located in the GWNF (**Table 1**). The change in the number of test pits from the Protocols occurred due to the following:

- As additional geospatial property data was made available and as portions of the Rev-10 route were confirmed, nine proposed test pit locations were added to the MNF for a total of 89 (P-001 to P-089) and 54 proposed test pit locations were added in the GWNF, with 21 of those being added for the Rev-11 reroute, for a total of 264 (P-090 to P-353) proposed test pit locations in the GWNF.
- Access to 18 of the proposed test pit locations (P-315 to P-332) in the GWNF is currently restricted pending cultural clearance.
- Based on differences of U.S. Forest Service property boundaries observed in the field from the boundaries obtained during the desktop study, seven (7) proposed soil test pit locations (P-013 to P-016 in the MNF and P-168, P-169, and P-198 in the GWNF) were eliminated and three (3) proposed test pits (P-216A, P-216B, P-353A in the GWNF) were added.
- Six (6) proposed test pit locations (P-017 to P-021 in the MNF, and P-194 in the GWNF) were eliminated due to the presence of roadways separating the U.S. Forest Service property from the pipeline center line on private property. In these locations the pipeline centerline is located on private property and no land disturbance would occur on U.S. Forest Service property associated with the proposed Project.
- A total of 35 additional test pits were added at the discretion of the soil scientists in the field to describe another soil type or landform not represented by the proposed test pits. Sixteen (16) of those additional soil test pits were conducted during the field investigation and are identified with a letter in the test pit ID number (e.g. P-###A) and 19 of the additional soil test pits were Recon pits.

Table 1 summarizes the test pit allocation between the MNF and GWNF and the total number of soil test pit observations. When a Recon pit was located in proximity to a proposed test pit location and the landform was adequately described by the Recon pit, then the Recon pit was used to map the landform. However, if the Recon pit did not adequately describe the landform, then an additional test pit was added in that area. **Attachment 2** identifies the Recon pit locations in proximity to proposed soil test pit locations. Transect soil observations (shallow observations with an abbreviated description) were conducted in various locations to assist in the refinement of soil boundaries or to verify that soils on different slopes or aspects were consistent with soil test pit observations. A total of 65 transect point observations were conducted with 17 in the MNF and 48 in the GWNF. Test pit and transect point locations are identified on the project maps in **Attachment 1**. Test pit logs are provided in **Attachment 4**, and Transect logs are provided in **Attachment 5**.

Table 1. Allocation of each soil test pit conducted in the MNF and GWNF.

Test Pit Type	MNF	GWNF	Total
Proposed Test Pits (≈350-foot spacing)	73	242	315
Additional Test Pits	1	15	16
Recon Pits - Used as Proposed Test Pits (≈350-foot spacing)	7	3	10
Recon Pits - Used as Additional Test Pits	4	15	19
Total	**85**	**275**	**360**

4.0 SOIL MAPPING

4.1 Mapping Key

Soil units were delineated during the Survey based on changes observed in the soil profiles with regard to the seven components identified on the ACP Soil Mapping Key developed for the Project including: 1) Parent Material; 2) Slope Class; 3) Drainage Class; 4) Diagnostic Subsurface Horizons; 5) Restrictive Layer Type; 6) Depth to Restrictive Layer; and 7) Family Particle Size Class. A detailed description of each of the ACP Soil Mapping Key components are discussed below and a concise version of the ACP Soil Mapping Key and the component symbology is included in **Attachment 6**. The Mapping Key uses numbers or letters to represent each component in a set order. **Figure 1** provides an example of a delineated soil unit ID with call-outs to identify each component.

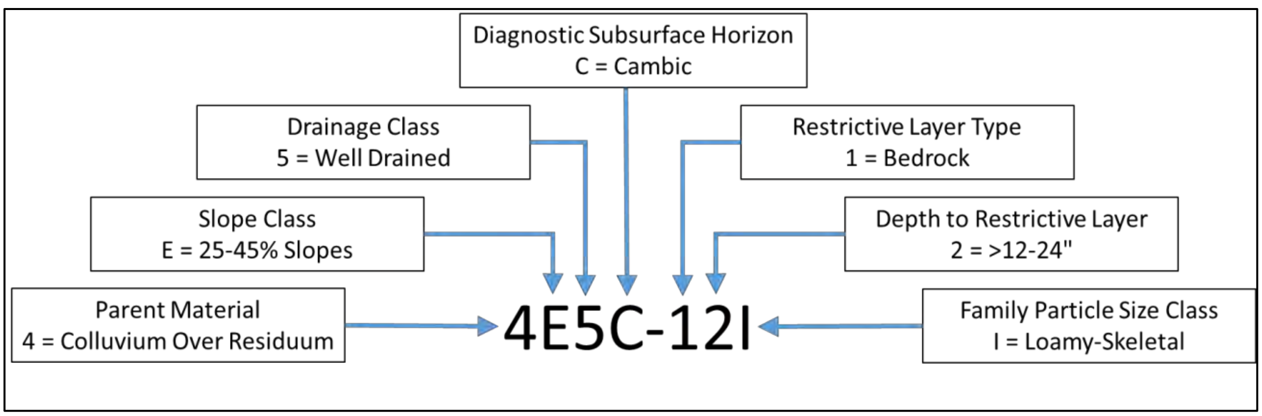


Figure 1. Example delineated soil unit ID with call out boxes describing the symbology used in the set order of components.

4.1.1 Parent Material

Parent material was observed by the soil scientist, and then one of the 10 numeric codes below were assigned to the map unit.

1. **Residuum**- soil material that has formed in place. Generally evidenced by coarse fragments with similar orientation to bedrock, and presence of a lithic or paralithic contact.
2. **Alluvium** – soil material that has been transported and deposited by water. Generally, evidenced by highly rounded coarse fragments and sorting of grain sizes.
3. **Colluvium** – soil material that has been moved by gravity. Generally, evidenced by random coarse fragment orientation, or mixtures of coarse fragment types in a horizon.

4. **Colluvium over Residuum** – a deposit(s) of colluvial material overlying residual soil material. Colluvium must extend deeper than the A-horizons to be considered a significant component.
5. **Colluvium over Alluvium** – a deposit(s) of colluvial material overlying alluvial material.
6. **Human Transported Materials (HTM)** – material that has been disturbed through excavation or relocation due to anthropogenic activity.
7. **Organic Soil Materials** – Accumulation of organic matter to have organic soil horizons (greater than 12-18% carbon depending on clay content) that are 16 inches or more thick. (None observed during soil survey)
8. **Alluvium over Colluvium** – a deposit(s) of alluvial material overlying colluvial material.
9. **HTM over Colluvium** – a deposit(s) of HTM on top of colluvial material.
10. **Alluvium over Residuum** – a deposit of alluvial material overlying residual soil material.

4.1.2 Slope Class

Slopes were measured with inclinometers or Abney levels to assign slope classes for mapping units. On landforms where the slope rapidly changed over too short of a distance to delineate separate units, then slope classes were lumped by using all of the letters that symbolize the range in slope classes within that delineated soil unit (e.g. BC - >3-15% slopes). Slope classes and symbology are provided in **Table 2**.

Table 2. Slope classes and their symbology used in the delineated soil map unit ID.

Symbol	Slope Range
A	0-3%
B	>3-8%
C	>8-15%
D	>15-25%
E	>25-45%
F	>45-70%
G	>70%

4.1.3 Drainage Classes

Drainage classes were assigned based on identification of zones of saturation indicated by the presence of redoximorphic features (redox), and/or interpretation of rate of water movement through the soil based on texture, coarse fragment content, depth to bedrock, and slope (**Table 3**).

Table 3. Drainage classes, delineated soil map unit ID symbology, and criteria used to assign them to a soil test profile.

Symbol	Drainage Class	Criteria
1	**Very Poorly**	Thick dark surface with depleted matrix underneath
2	**Poorly**	Redox shallower than 8 inches
3	**Somewhat Poorly**	Redox from 8 to less than 20 inches
4	**Moderately Well**	Redox from 20 to less than 40 inches
5	**Well**	Redox greater than or equal to 40 inches, and bedrock occurs deeper than 20 inches
6	**Somewhat Excessively**	Soils that are coarse textured, skeletal, or 10 to 20 inches to bedrock, and/or on steep slopes
7	**Excessively**	Soils that are coarse textured, skeletal, or less than 10 inches to bedrock, and/or on steep slopes

4.1.4 Diagnostic Subsurface Horizons

Diagnostic subsurface horizons form below the surface and are typically associated with B-horizons. Diagnostic subsurface horizons were identified by morphological characteristics. When multiple subsurface horizons were present in a profile without a lithologic discontinuity, both were included in the delineated soil unit ID (e.g. a soil with argillic horizons and a fragipan = AB). Diagnostic subsurface horizons separated by a lithologic discontinuity were presented with a "/" between the upper and lower components of the discontinuity. Diagnostic subsurface horizons identified during the survey, and their morphological criteria, included:

A. **Argillic** – a subsurface horizon with an accumulation of clay translocated from the overlying materials as evidenced by argillans (aka: clay films, coatings, or skins) or bridging in sandy soils (Alfisols or Ultisols).
B. **Fragipan** – a subsurface horizon that is dense and restricts rooting depth and perches water. Characterized by its firmness, brittleness, and very coarse structure (Alfisols, Ultisols, or Inceptisols).
C. **Cambic** – a subsurface horizon that has shown soil development of two or more processes (Inceptisols).
D. **Spodic** – a subsurface horizon that has formed under acidic conditions that result in an illuvial accumulation of aluminum-organic complexes with or without iron (Spodosols).
E. **None** – no subsurface horizon meets the criteria for any diagnostic subsurface horizon (Entisols), including any horizon that does not meet thickness requirements (e.g. a Bw horizon <6-inches thick).

4.1.5 Restrictive Layer Type

A restrictive layer is a horizon that inhibits root growth and downward movement of water. Paralithic layers are normally considered root limiting (Keys to Soil Taxonomy, 12^{th} edition, *2014*). However, most paralithic layers observed during the Survey were composed of soft highly weathered shales or siltstones, or contained highly fractured rock and tended to contain few roots. For the purpose of this Survey, paralithic layers were not identified as restrictive layers, but have been identified on the soil logs when present. The restrictive layer symbology is presented in **Table 4**.

Table 4. Root limiting layer types and the delineated soil map unit ID symbology.

Symbol	Restrictive Layer Type
0	None
1	Bedrock
2	Fragipan

4.1.6 Depth to Restrictive Layer

The depth to a restrictive feature (**Table 5**) is defined by depth classes where the depth to the top of any root restrictive layer occurs. When excavations were limited by a water table or by coarse fragments, and observations were stopped prior to observing a restrictive layer or 50 inches, then the depth class was assigned based on the depth of observation in the soil test pit with a restrictive layer type of "None" (e.g. soil observation stopped at a depth of 22 inches due to a water table, therefore the Restrictive Layer Type is "0" and the Depth Class is "2").

Table 5. Depth to restrictive layer from the soil surface and the representative delineated soil map unit ID symbology.

Symbol	Depth Classes
1	≤12"
2	>12-24"
3	>24-36"
4	>36-48"
5	>48"

4.1.7 Family Particle Size Class

Family particle size class was assigned based on the control section and as defined by Keys to Soil Taxonomy, 12th edition (2014). A list of the family particle size classes and their delineated soil map unit symbology is provided in **Table 6**. Profiles that contained contrasting family particle size classes due to lithologic discontinuities are represented with a "/" between the upper and lower portions of the control sections.

Table 6. Family particle size class as defined by Keys to Soil Taxonomy 12th edition and their delineated soil map unit ID symbology.

Symbol	Family Particle Size Class
A	Coarse Silty
B	Fine Silty
C	Coarse Loamy
D	Fine Loamy
E	Sandy
F	Fine
G	Very Fine
H	Sandy-Skeletal
I	Loamy-Skeletal
J	Clayey-Skeletal
K	Clayey

4.2 Map Generation

During the Survey, boundaries were sketched on field maps to delineate soil map units based on changes in the seven components of the ACP Soil Mapping Key (**Attachment 6**) described in **Section 4.1.** GPS points (with sub-meter accuracy) were recorded to assist in the digitization of the delineated soil map units. Maps of adjacent areas were compared and joined the same day as they were drafted by the soil scientists. The hand-sketched field maps with the delineated soil map unit boundaries were scanned and georeferenced into ArcGIS to trace the hand drawn maps and reference with GPS data to generate delineated soil map in **Attachment 1**. The field-sketched maps and soil maps were prepared at a 1:2,400 scale. Delineated soil map units were labeled using the ACP Soil Mapping Key.

4.3 Mapping Assumptions

Soil mapping was conducted by U.S. Forest Service approved professional soil scientists. The mapping was conducted at an Order 1 scale (1:2,400) to map each individual soil unit on the landscape within the proposed pipeline corridor. However, soils are spatially dynamic and excavations within a delineated soil unit may result in the observation of slightly different soil properties due to the inherent variability in soil. One specific soil property that is likely to vary within delineated soil units is the family particle size class. A significant number of the soil test pits had soils with clay percentages which placed them near the break-point between the family particle size classes of 'fine loamy' and 'coarse loamy' or had coarse fragment contents which placed them close to being classified as 'skeletal.' The delineation between soils that differed only in family particle size class or another subtle property were conducted based on the professional judgment of the soil scientists.

The delineation of soil map units did not necessarily involve a soil test pit or transect point in each delineated map unit. Soil delineation IDs were assigned based on the observed relationships between soils and landscapes, which included identifying underlying parent materials, noting vegetative communities, and relating soil information from similar landscapes and nearby soil observations as a guide.

5.0 SOIL SAMPLE LABORATORY DATA

During the Survey a total of 511 soil samples were collected by soil horizon in duplicates from 111 test pits. The sampled test pits were examined, and a total of 41 test pits were selected to represent a variety of soil delineations and soil types. The 41 soil test pits contained a total of 190 sampled horizons. One set of the duplicate soil samples were sent the Pennsylvania State University Agricultural Analytical Services Laboratory (AASLAB) to be analyzed for soil particle size, pH and standard fertility testing (including determination of P, K, Mg, Ca, Zn, Cu, S, Acidity, CEC, and limestone and Mg application recommendations). The second set of duplicate soil samples were sent to ALS Environmental for determination of total carbon and organic carbon content. A summary data table is available in **Attachment 7**. The data reports from the AASLAB for the soil fertility testing are provided in **Attachment 8** and particle size analysis in **Attachment 9** and the data reports from the ALS Environmental laboratory for total organic carbon (TOC) and total carbon (Loss on ignition [LOI]) are provided in **Attachment 10**.

6.0 OBSERVATIONS

6.1 Soil and Parent Material Observations

A table presenting a summary of observations of the seven components of the ACP Soil Mapping Key is presented in **Attachment 11**, including the number of observations for each component class in the MNF and GWNF. The Project area is dominated by steep ridge and valley topography. The Project's centerline within the Survey area is predominately located on ridgelines with steep side slopes. When the Project route continued off the ridgelines it would travel straight down the steep slopes into and out of the intervening narrow valleys. With the route favoring the ridgelines, 82 percent of the soil test pits had a residual soil component (formed in place) and 61 percent of the soil test pits had a colluvial soil component due to the presence of steep slopes. The majority of the colluvium observed consisted of relatively thin deposits over residuum. This colluvium likely moved only short distances (e.g. from the shoulder to backslope) resultant of minor erosion/deposition events or slow creep over the centuries which has resulted in the material to be dislocated sufficiently by gravity to create random coarse fragment orientations. A few thicker colluvial deposits were observed primarily on footslope or headslope (concave backslope) positions, although some headslope positions were erosive landforms that were shallow to bedrock. In addition, evidence of colluvium was also observed in some of the A-horizons formed on the summits of secondary ridgelines (secondary ridges are those situated at lower elevations compared to major ridges which have the highest elevations in the region). Colluvium observed on the secondary ridgelines was likely transported from the higher elevation primary ridges during periods of landscape instability. Fragipans or fragic properties were observed in seven soil test pits situated in broader valleys on terraces, typically formed in colluvial material. In the high elevations of the MNF (P-068) and the westernmost end of the GWNF (P-090), evidence of frost churning (such as flagstones sticking vertically out of the ground) was observed in the upper portion of the soil profiles.

Topsoil (O and A-horizons) thickness ranged between 0.5 inches and 10 inches thick with an average of 3.1 inches between all of the test pits and transect observations. O-horizons (excluding duff) ranged from being absent to 6 inches thick with an average of 1.5 inches across all profiles. A-Horizons ranged from being absent to 7 inches thick, with an average thickness of 1.7 inches. When examining these horizons in relation to their landform position (**Table 7**), the lower landscape positions, such as footslopes and headslopes, that tend to be moister environments have thinner O horizons, but thicker A horizons relative to the higher and more xeric landscape positions. This may be a result of increased microbial activity decomposing the O horizons at a higher rate due to presence of more moisture.

Table 7. Thickness of topsoil (combined O and A-Horizons), O-horizons, and A-horizons for different landform positions or groups of landforms.

Landform Position	Topsoil (O- and A-Horizons) Thickness (in)	O-Horizon Thickness (in)	A-horizons Thickness (in)
Summit	2.9	1.5	1.4
Nose	2.6	1.6	1.1
Shoulder	3.2	1.6	1.6
Backslope	3.3	1.6	1.7
Footslope/Toeslope/Floodplain/Terrace	3.5	1.1	2.4
Headslope	3.0	0.8	2.2

With the Project route favoring the ridgelines, 87 percent of the test pits were well drained to excessively drained. Only one profile described was identified as poorly drained and less than 5 percent were classified as somewhat poorly drained.

Within the 360 soil test pits, restrictive layers were observed in 255 (71%) of the test pits. Of those with restrictive layers, 248 (97% of restrictive layers, 69% overall) had a lithic contact and seven (3% of restrictive layers, 2% overall) had a fragipan or fragic properties. Of the remaining 105 (29%) test pits that did not exhibit a restrictive layer, 25 (24% of no limiting layer, 7% overall) had a paralithic contact and eight (8% of no limiting layer, 2% overall) had refusal due to the presence of a water table.

Bedrock was primarily composed of siltstone or sandstone with approximately 41 percent containing siltstone and 38 percent containing sandstone. Shale coarse fragments were observed in the majority of the soil test pits, but shale was only identified as bedrock in 18 percent of the test pits where bedrock was observed. Limestone derived soils were observed in four test pits located in the GWNF (P-172, P-173, P-175, and P-176). In addition, soils that potentially have some limestone influence were observed in two Recon pits (R-028 and R-029) located in the MNF. One instance of breccia as bedrock was observed in test pit P-027 in the MNF.

Dip of bedrock varied greatly throughout the Project route. In the MNF the dip ranged from nearly level (1°) to as much as 42°, with every observation of a 22° dip or greater being located east of Route 92. In the GWNF, the dip was highly variable, from 1° to 90°, with all instances of dip steeper than 45° occurring from test pit P-189 eastward (near MP 99.6). Due to the limited bedrock exposure in the test pits, the measured dips should be considered qualitative, as bedding actual planes were difficult to discern.

6.2 Slopes and Evidence of Slope Failure Observations

Slopes observed along the Project route were fairly steep with 32 percent of the soil test pits (113) located on slopes ranging from 45 to 70 percent. As a result of the abundance of steep slopes, colluvium (soil material moved by gravity) was observed in 61 percent of the soil test pits, most of which was shallow local colluvium (over residuum) that over time has slowly crept down backslopes. This type of mass movement is not associated with slope failures.

Features indicating evidence of former landslides or slope movement, such as bent or leaning tree trunks, surface cracking or scarps, or shallow slip planes were observed during the Survey. Several instances of leaning trees or trees with bent bases were observed in the vicinity of test pits P-103, P-104, P-146, P-163, P-164, P-165, P-180, P-183, P-184, P-262, P-275, and P-333 in the GWNF; however, no indications of soil movement were observed in these areas other than the fact that all but two (P-184, P-275) contained a colluvial soil component. Surface sloughing was observed in the vicinity of test pit P-347 (REV 11 approximate MP 98.7) in the GWNF on a steep slope where the depth to bedrock was very shallow. One instance of an interpreted former slope failure was observed in the vicinity of T-312A, R-012, and R-013 in the GWNF. The slide scarp was in the vicinity of R-013 with the hummocky debris field in the vicinity of R-012 and T-312A (REV 11 approximate MP 123.0 to 123.1). Mature trees have been established in this historical slide area. A second possible historical slide was observed in the vicinity of R-007 (REV 11 approximate MP 155.0) in the GWNF; however, more data will be collected in this area when access is obtained to complete the Survey.

Throughout the Project, the predominant soil textures observed in the field were silt loams. The ridgelines and steep backslopes were mostly comprised of soil material with this silt-rich texture. The silt particle size (2-50 µm) is the most susceptible to erosion due to its light weight and minimal cohesiveness. Erosion and sediment control measures will be critical during and post construction with soil material that is highly susceptible to erosion, especially on steep slopes. Particle size analysis results are presented in **Attachments 7** and **9**. Initial review of these results shows some variations from textures conducted in the field. Additional analyses will be conducted to verify the lab results received by RETTEW and will be provided when available.

6.3 Soil Chemistry Observations

A summary of laboratory results is provided in **Attachment 7**. Copies of the original data from AASLAB for the nutrient analysis is provided in **Attachment 8**. Copies of the TOC and total volatile solids data from ALS Environmental is provided in **Attachment 10**. TOC is the mass of organic carbon per mass of soil and can be represented as a percentage. The total volatile solids represents the organic and non-organic carbon (carbonates) contents of the soil.

In general, nutrient contents and pH were below optimum levels, primarily a result of the acidic and nutrient poor geology. These below optimum levels pose a challenge for restoration, as the native species growing in this environment are adapted to the low pH and nutrient levels; some species prefer to grow in mildly acidic soils. For an accelerated reestablishment of vegetation, soils should be fertilized and limed. However, care should be taken in the determination of the quantities of fertilizer and lime to be applied, as over fertilization or liming could result in a shift in vegetative communities within the restoration corridor and could affect other ecosystems, such as acidic bogs, if downstream of the corridor.

Three test pits were observed to have contained spodic horizons in the MNF (P-012 and P-022) and in the GWNF (P-170) and had higher levels of carbon deeper in the profile (17, 14, and 5.6 inches in P-012, P-022, and P-170, respectively) in the Bhs and Bs horizons compared to non-spodic soils where percent organic carbon generally drops below 1 % carbon for subsurface horizons. The O and A horizons were high in organic carbon, with averages of 32.4 percent and 6.1 percent respectively. The sub soil, excluding spodic horizons, had an average organic content of 0.9 percent. The high quantity of carbon was anticipated in the surface horizons; however the thickness of these horizons was relatively thin (**Section 6.1**).

Based on an estimated bulk density (not measured during survey) of 0.2 g cm^{-3} for the O-horizons, 1.2 g cm^{-3} for the A-horizons, and 1.4 g cm^{-3} for subsoil horizons it would be estimated that the O-horizons, A-horizons and Subsoil horizons would contain about 64.8 mg C cm^{-3}, 73.2 mg C cm^{-3}, and 12.6 mg C cm^{-3} respectively. Due to their interaction with the environment, surface horizons provide numerous ecosystem services as a result of the higher organic carbon contents and biotic interactions including facilitating higher infiltration rates, carbon sequestration, nutrient cycling, providing a seed bank, etc. Carbon contents are dynamic because they are a balance between vegetative inputs and decomposition rates. Complete loss of these layers during construction would require decades of high inputs to recover. Conservation of these layers during construction and replacement following construction will ensure a faster recovery and provide ecosystem services that would assist in the restoration of these habitats.

Soils tended to be acidic with a pH ranging from 3.1 to 6.7 with an average (accounting for log scale) of 5.2. The lowest and highest pH values were observed in O horizons. Certain vegetative species can have an influence on soil pH, particularly pines. The Project route was primarily dominated by chestnut oak. Pines were mostly observed to grow sporadically with only a few instances where white pine grew in greater populations in proximity to test pits. Examination of the extreme values observed in the O-horizons reveals that the higher values tend to be in vegetative communities dominated by species of maple, while the more acidic O-horizons tend to be vegetated with chestnut oak, white pine, mountain laurel, and blueberry. The pH of the subsoil tends to be more driven by the geology rather than vegetation. The majority of the route contained siltstone, shale, and sandstone soils which tend to be slightly acidic. The pH of the subsoil (excluding O and A-horizons) ranged from 3.1 to 6.7 and had an average pH of 5.2, excluding limestone derived soils. The sub soil horizons that were derived from limestone had a pH that ranged from 5.2 to 6.8 with an average of 5.8.

7.0 SUMMARY

An Order 1 Soil Survey was completed for the ACP on behalf of Dominion Transmission, Inc. in the MNF and GWNF. The Survey resulted in the production of an Order 1 Soil survey with delineated soil map units (Attachment 1) determined through the use of the ACP Soil Mapping Key (**Attachment 6**). Soil test pit logs, transect logs, and laboratory test results for soil samples collected in the field are provided as **Attachments 3**, **4**, **5**, **7**, **8**, **9**, and **10**. The data gathered for the Survey may be utilized for environmental impact studies, geohazard studies, for assessing Best Management Practices (BMPs) for post construction restoration within the pipeline study corridor.

Overall the Project route is primarily situated on ridgelines and is primarily comprised of residual soil material with the observation of bedrock, although due to the steep slopes colluvium is abundant. Most of the colluvium is relatively shallow with a residual base. Evidence of slope failures or movements were observed in two potential slides, and several bent or leaning trees. With the Project favoring the ridge tops, most soils are well drained to excessively drained. The nutrient analysis revealed that the soils are mildly acidic and nutrient levels are generally below optimum levels. Also, based on field observations, the soils have a high potential for erodibility due have a high silt fraction and the abundance of steep slopes, therefore it is critical to implement and maintain erosion and sediment control measures during and post construction.

A supplement to this report and mapping will be provided following the completion of the route Survey in the vicinity of MP 155 and MP 156 and when the additional particle size analyses are completed. ACP anticipates the Order 1 Soil Survey and report for this segment of the alignment will be completed June 2017.

8.0 GLOSSARY

Alluvium/Alluvial – A soil material that has been transported and deposited by water. Generally, evidenced by highly rounded coarse fragments and sorting of grain sizes.

Argillic – A subsurface horizon with an accumulation of clay translocated from the overlying materials as evidenced by argillans (aka: clay films, coatings, or skins) or bridging in sandy soils (Alfisols or Ultisols).

Alfisols – An Order of soils in soil taxonomy that have formed an argillic subsurface diagnostic horizon and a base saturation of greater than 35% in the control section.

Colluvium/Colluvial – soil material that has been moved by gravity. Generally, evidenced by random coarse fragment orientation, or mixtures of coarse fragment types in a horizon. Could be the result of slope creep or major slope failures.

Cambic – A subsurface horizon that has shown soil development of two or more processes (Inceptisols).

Depleted Matrix – A soil horizon that exhibits a gray matrix color (value 4 or more and chroma 2 or less) that has resulted from reduction and translocation of iron due to saturation and anaerobic conditions with or without Redoximorphic features.

Human Transported Materials (HTM) – Soil material that has been disturbed through excavation or relocation due to anthropogenic activity.

Entisols – An Order of soils in soil taxonomy that no diagnositic subsurface horizon is present. Usually soils of recent depositions, or highly erosive environments.

Fragipan – A subsurface horizon that is dense and restricts rooting depth and perches water. Characterized by its firmness, brittleness, and very coarse structure (Alfisols, Ultisols, or Inceptisols).

Fragic Properties – A subsoil horizon that possesses similar properties of a fragipan but fails to meet all of the requirements of a Fragipan. Similar properties include firmness and some brittleness. The layer containing fragic properties also acts as a root restricting layer and impedes downward movement of water, although not as effectively as a fragipan.

Inceptisols – An Order of soils in soil taxonomy that have had development in a few soil properties and exhibit a weakly developed B-horizon in the form of a cambic horizon.

Lithologic Discontinuity – A change in soil material that has formed from different parent materials. Two examples of a lithologic discontinuity would be colluvium deposited over residuum or residuum formed from sandstone overlying residuum formed from siltstone.

Organic Soil Materials – Accumulation of organic matter to have organic soil horizons (greater than 12-18% carbon depending on clay content) that are 16 inches or more thick. (None observed during the soil survey.

Paralithic – A layer of residual material that is comprised of rock that has weathered sufficiently to be excavated by hand either through softening of the rock, or fracturing the rock to allow fines in between bedding planes.

Particle size analysis – Analysis conducted to determine the proportion of the sand, silt, and clay fractions in a soil sample to determine a textural class.

Redoximorphic Features (Redox) – A morphological feature produced from the reduction and oxidation of iron in the soil due to saturated and anaerobic conditions.

Residuum/Residual – Soil material that has formed in place. Generally evidenced by coarse fragments with similar orientation to bedrock, and presence of a lithic or paralithic contact.

Spodic – A subsurface horizon that has formed under acidic conditions that result in an illuvial accumulation of aluminum-organic complexes with or without iron (Spodosols).

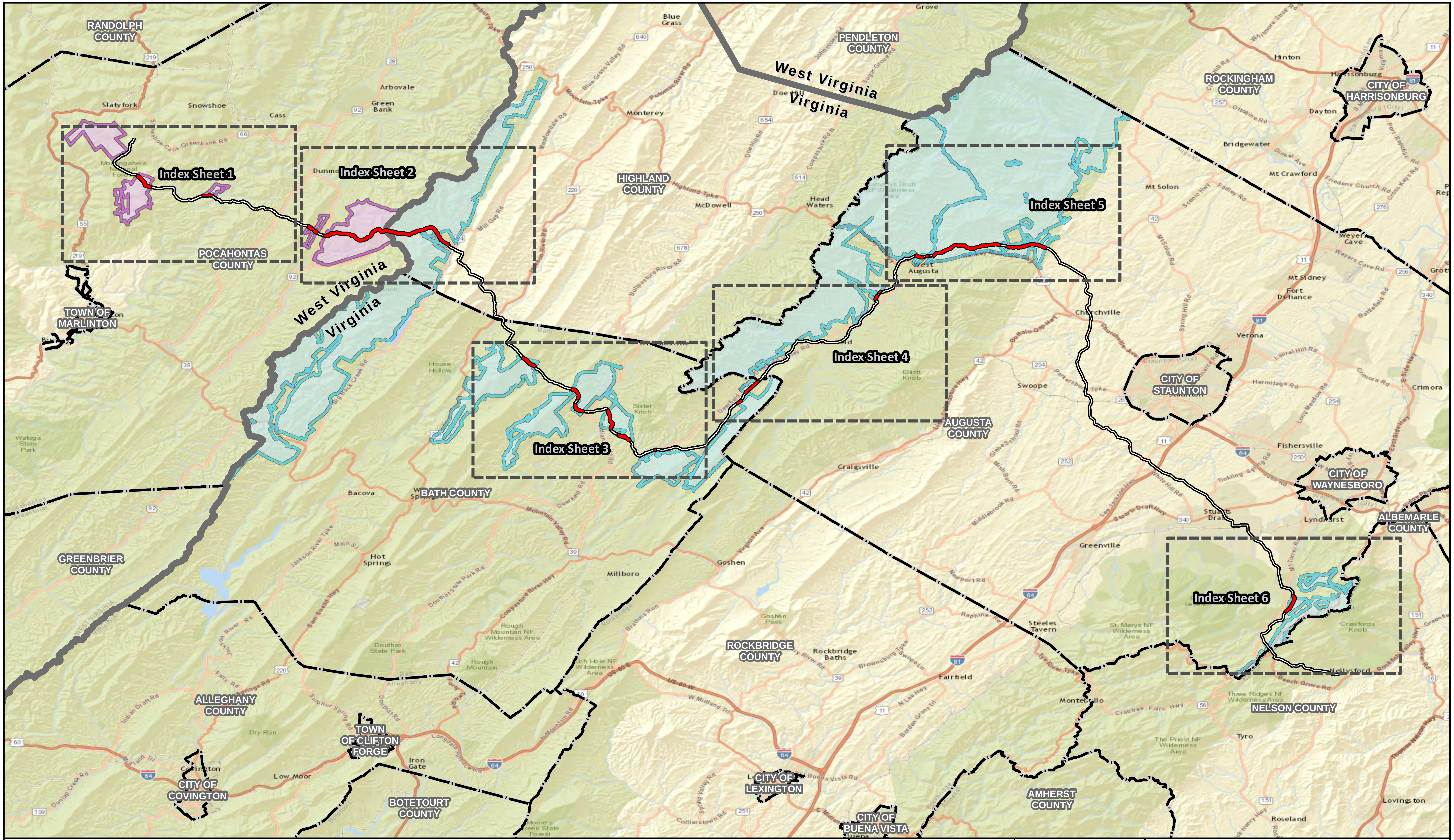
Spodosols – An Order of soils in soil taxonomy that are characterized by the presence of spodic horizons.

Ultisols – An Order of soils in soil taxonomy that have formed an argillic subsurface diagnostic horizon and a base saturation of less than 35% in the control section.

ATTACHMENTS

1. Project Mapping
2. Soil Observations Inventory
3. Reconnaissance Soil Test Pit Logs
4. Soil Survey Test Pit Logs
5. Soil Transect Logs
6. ACP Soil Mapping Key
7. Laboratory Results Summary
8. AASLAB Nutrient Analysis Results
9. AASLAB Particle Size Analysis
10. ALS Environmental TOC and LOI Results
11. ACP Soil Mapping Key – Soil Test Pit Observation Summary

Attachment 1
Project Mapping



Centerline Alignment (Rev-10 & Rev-11)	George Washington National Forest
Area of Investigation	Monongahela National Forest
County Boundary	Index Sheet
State Boundary	

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1 inch = 30,000 feet

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Order 1 Soil Survey

Cover Sheet

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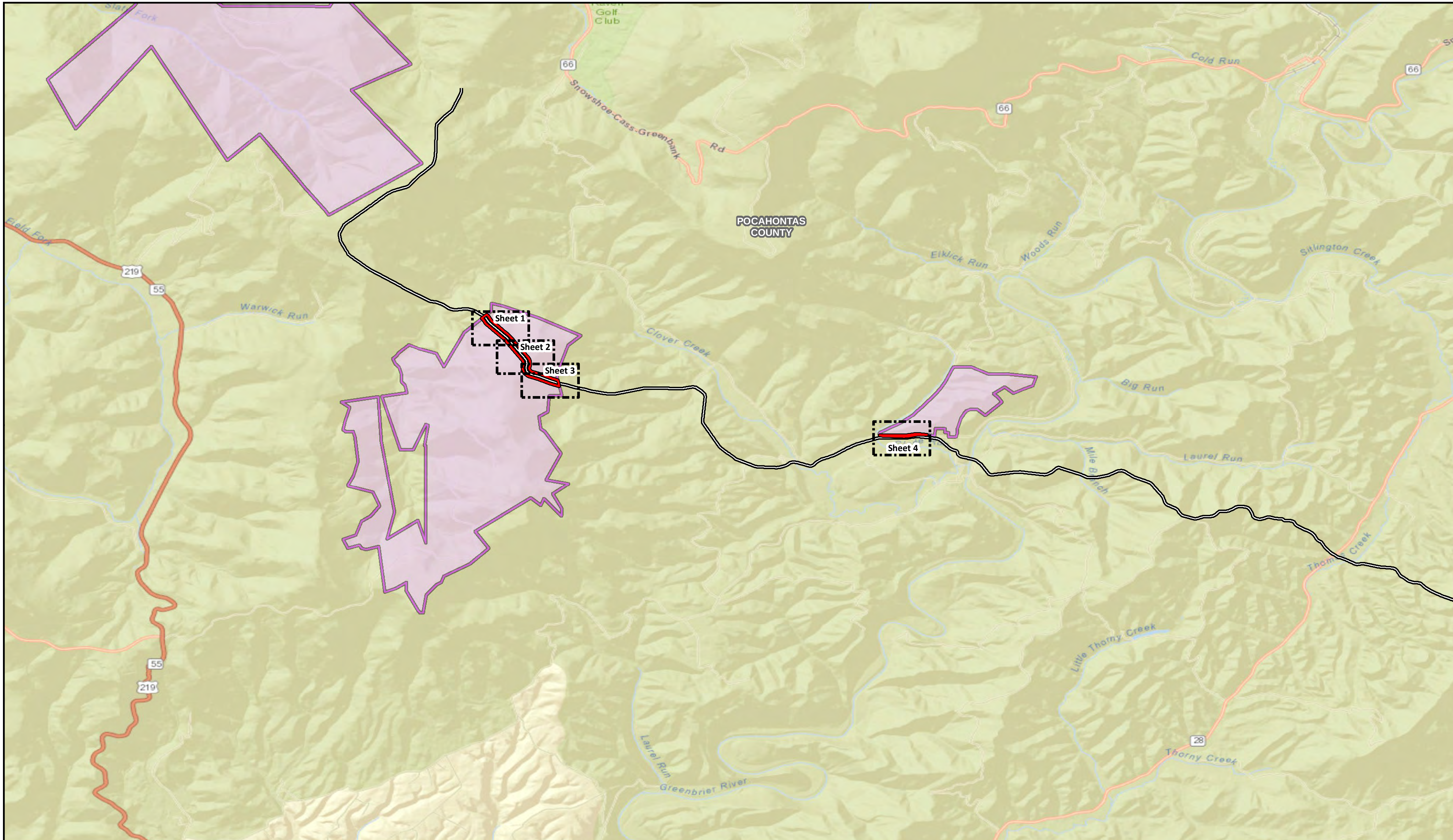

Centerline Alignment (Rev-10 & Rev-11)
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County Boundary
State Boundary
Grid Sheet

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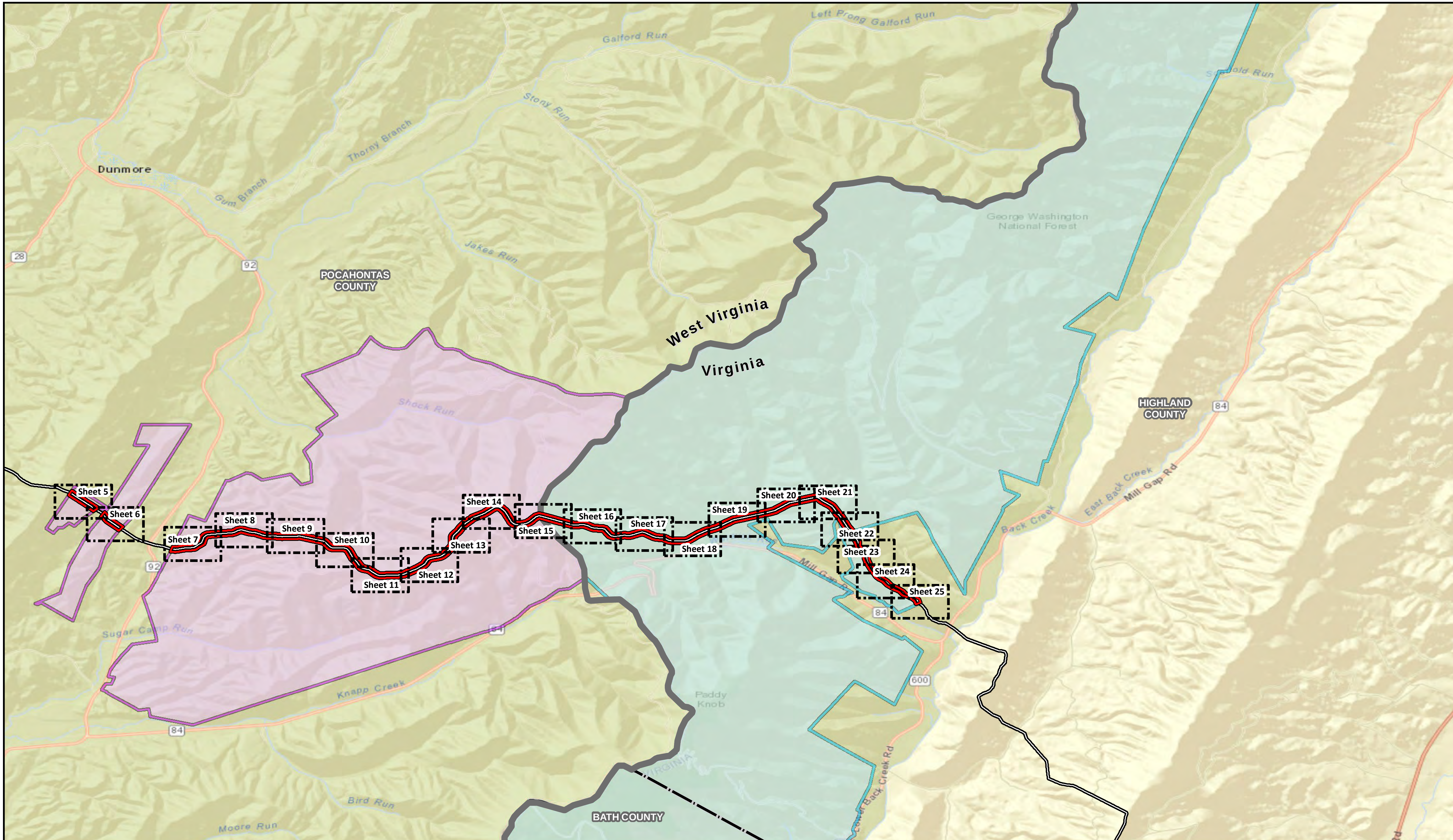

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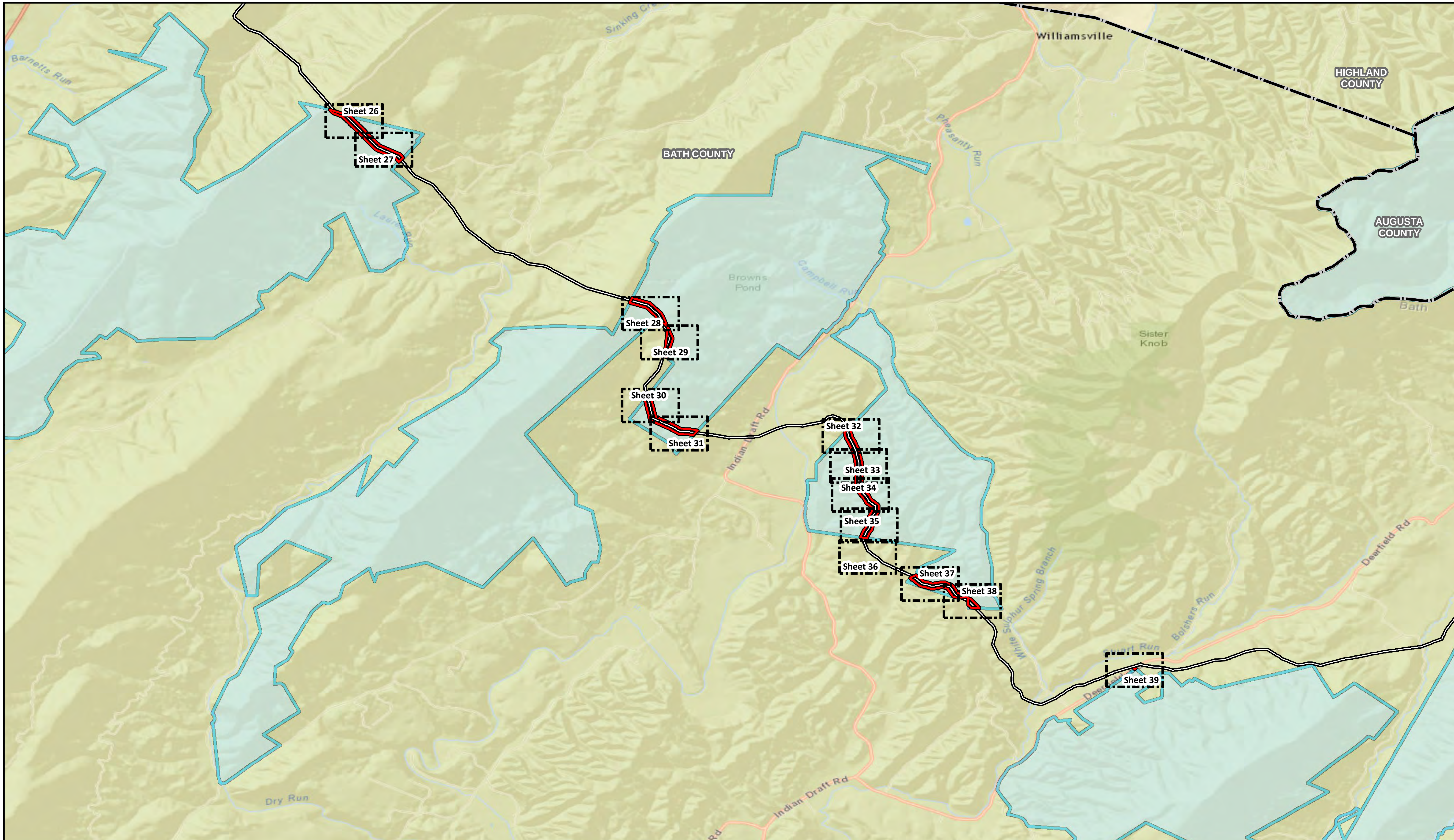

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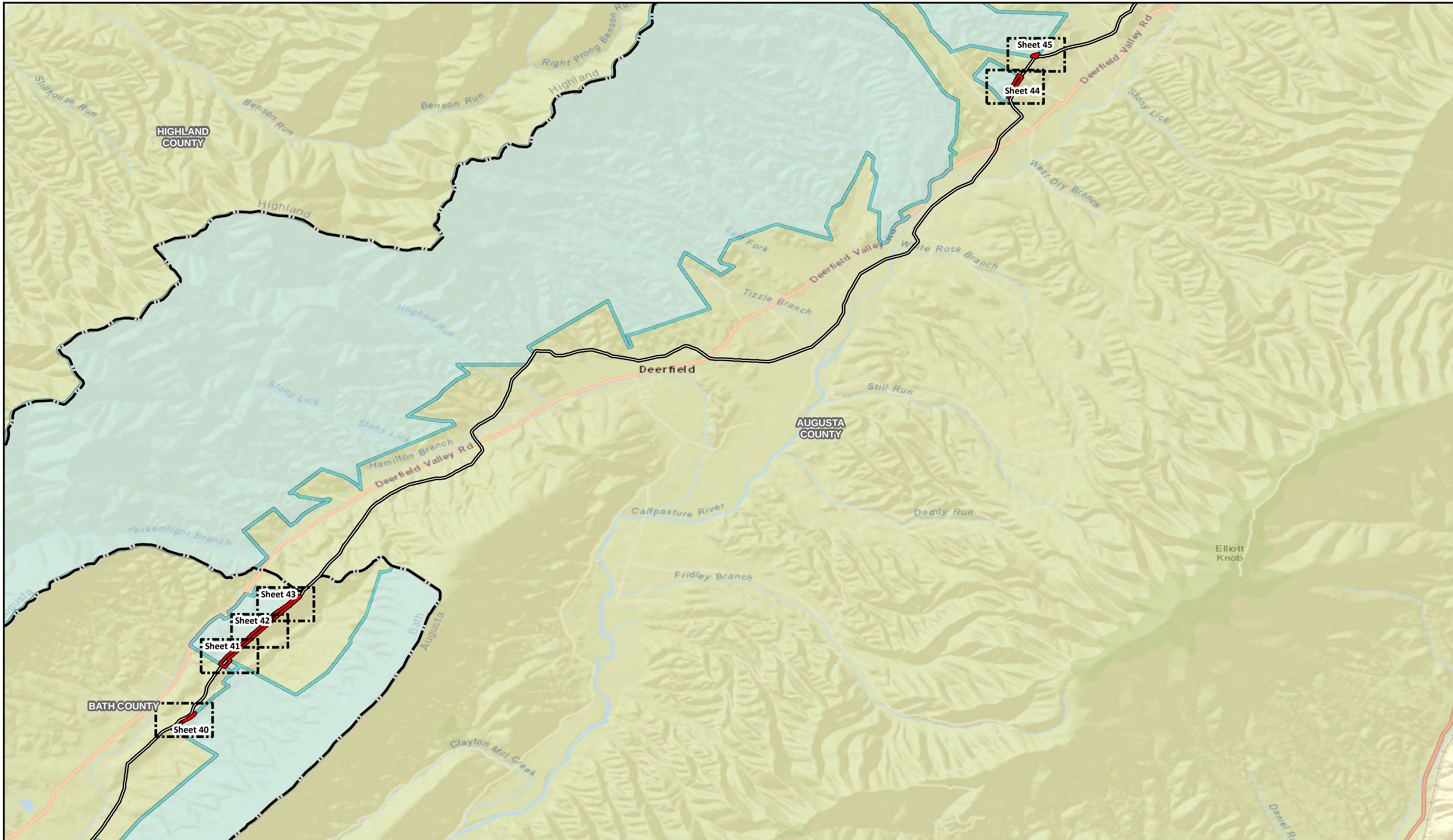

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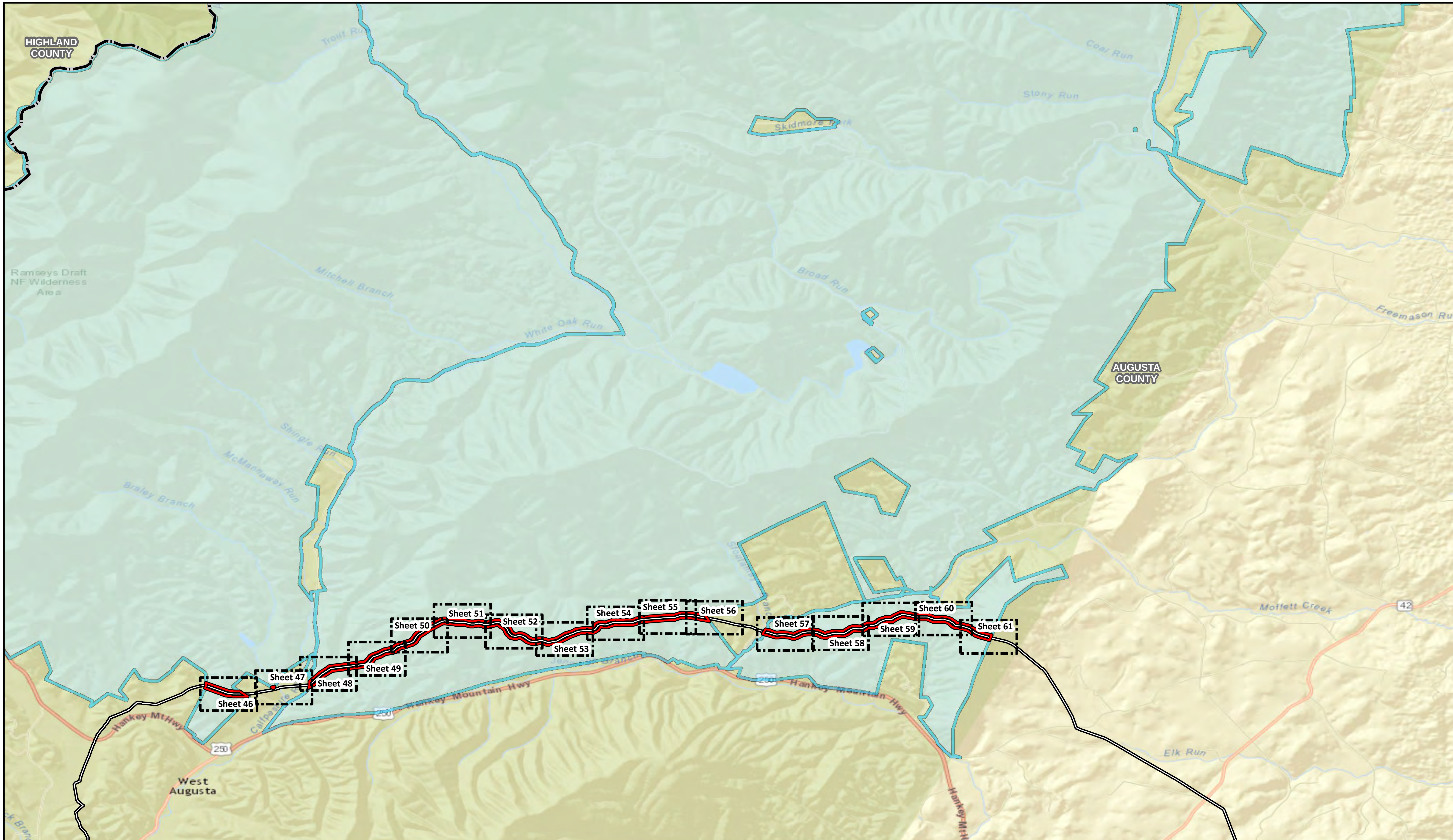

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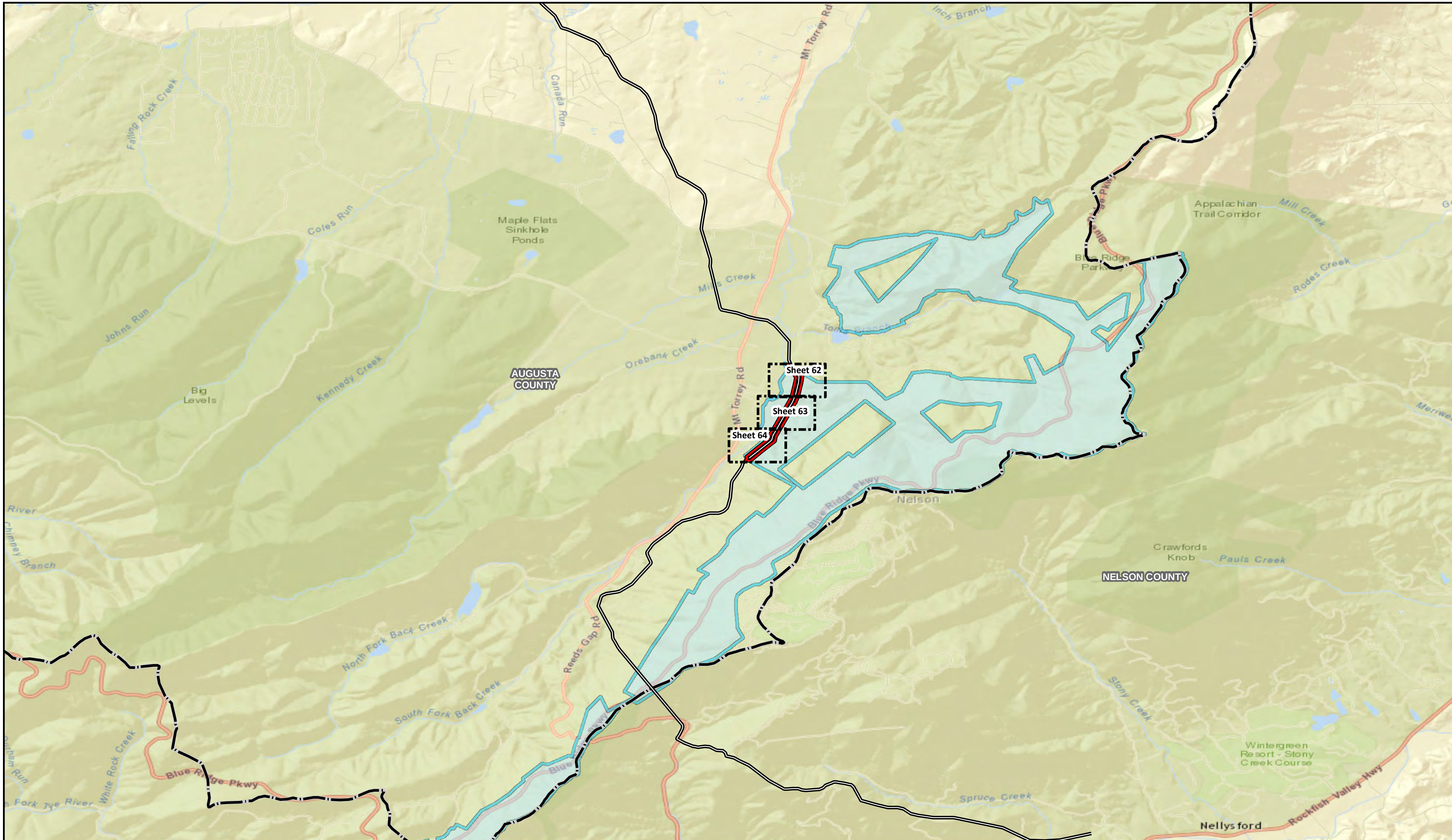

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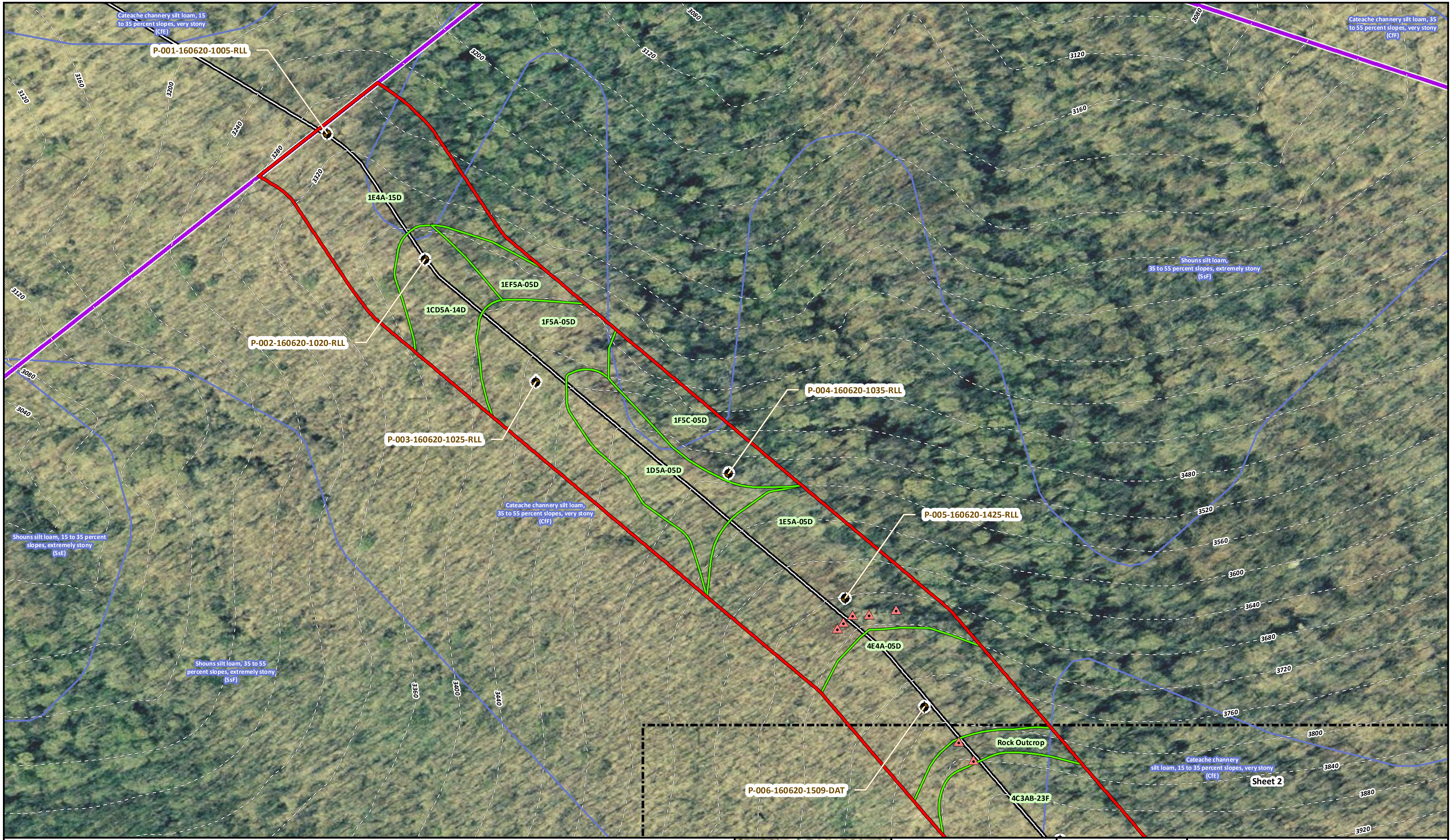

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
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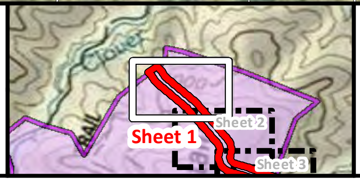
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet



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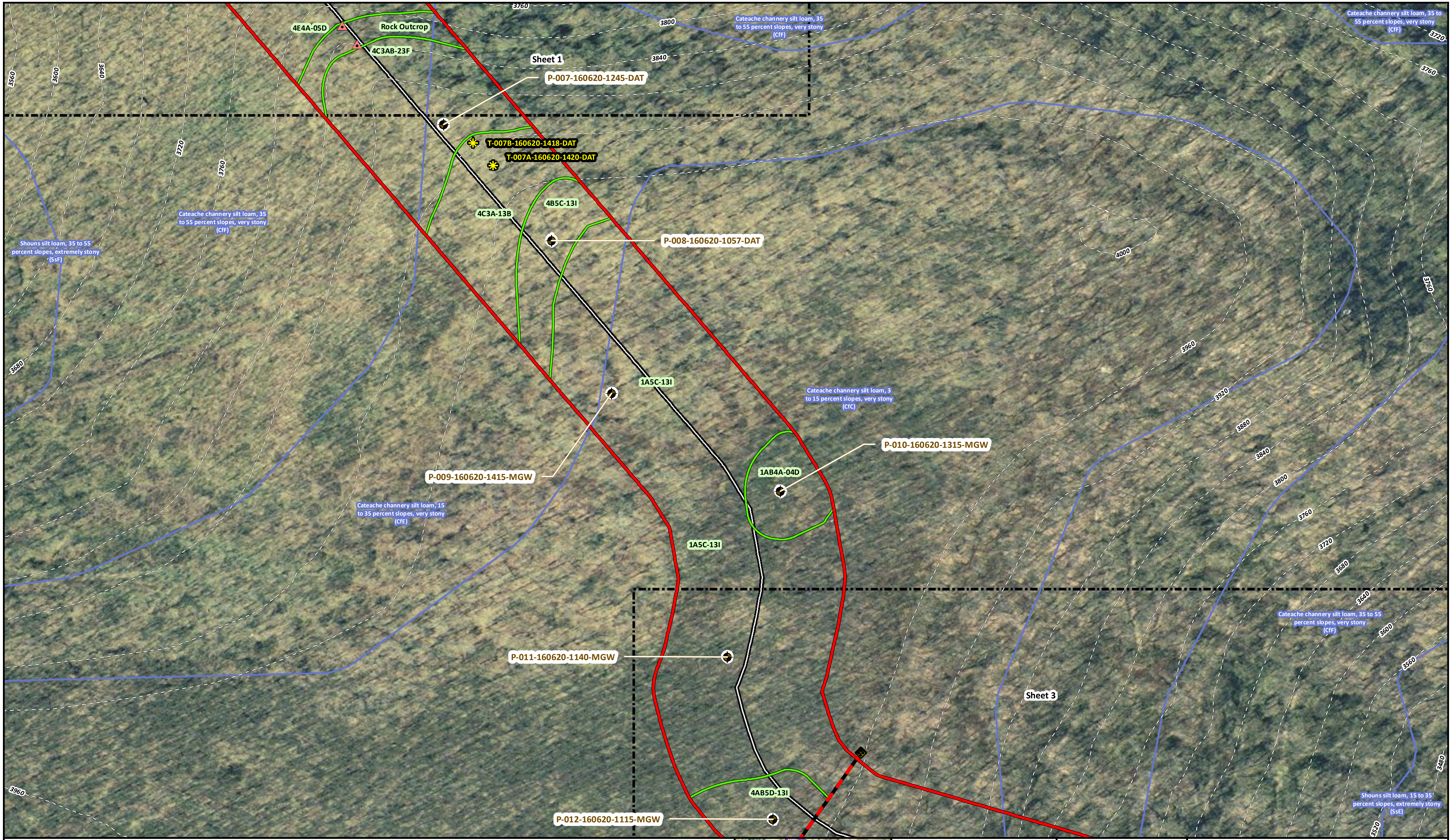

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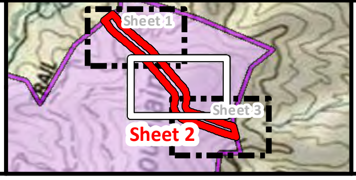

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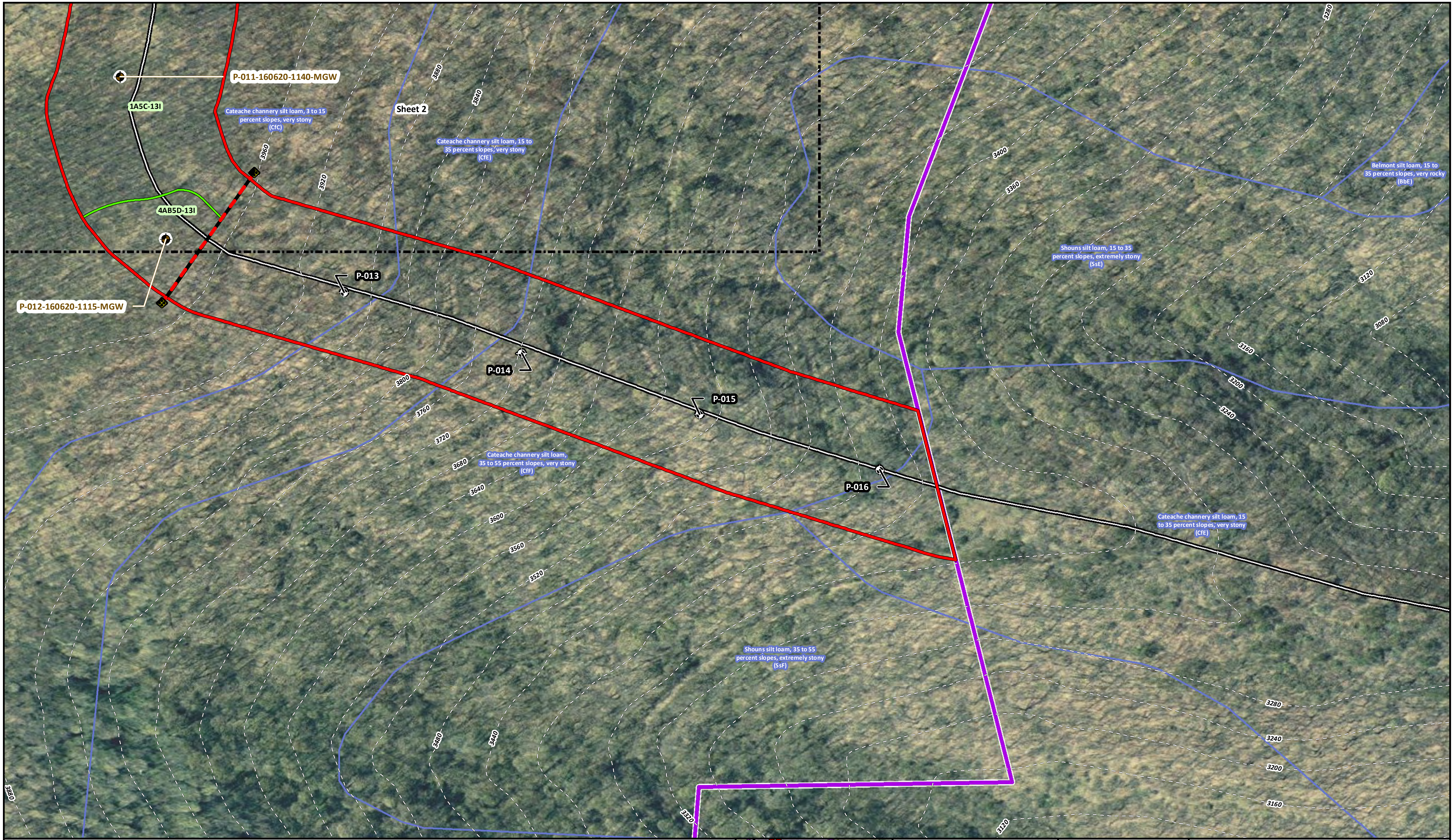

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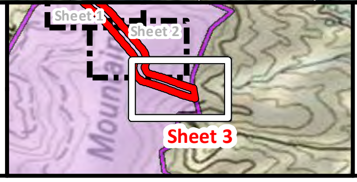

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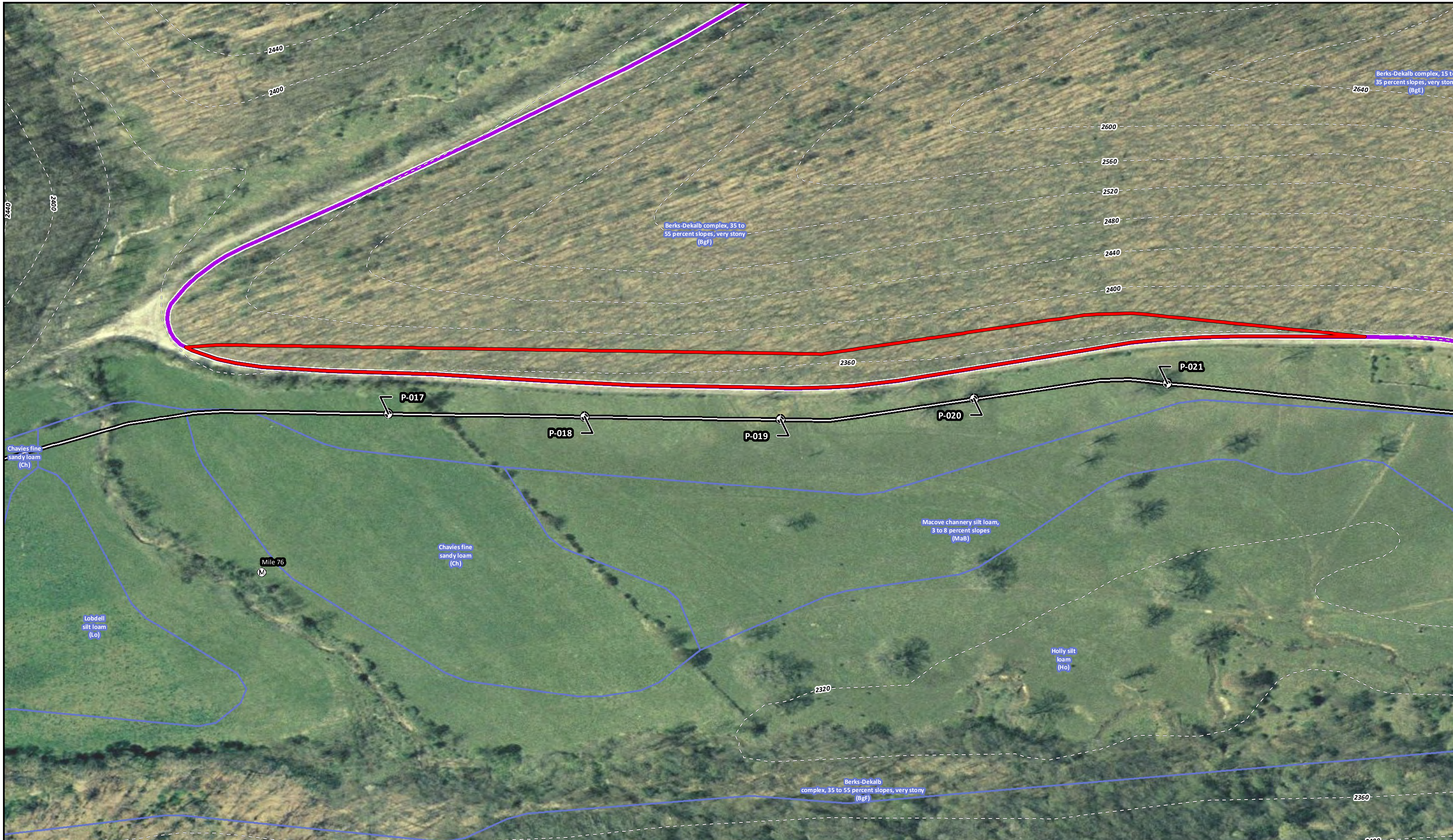

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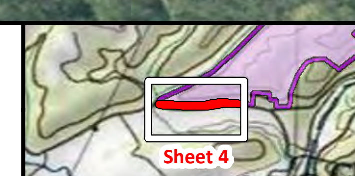

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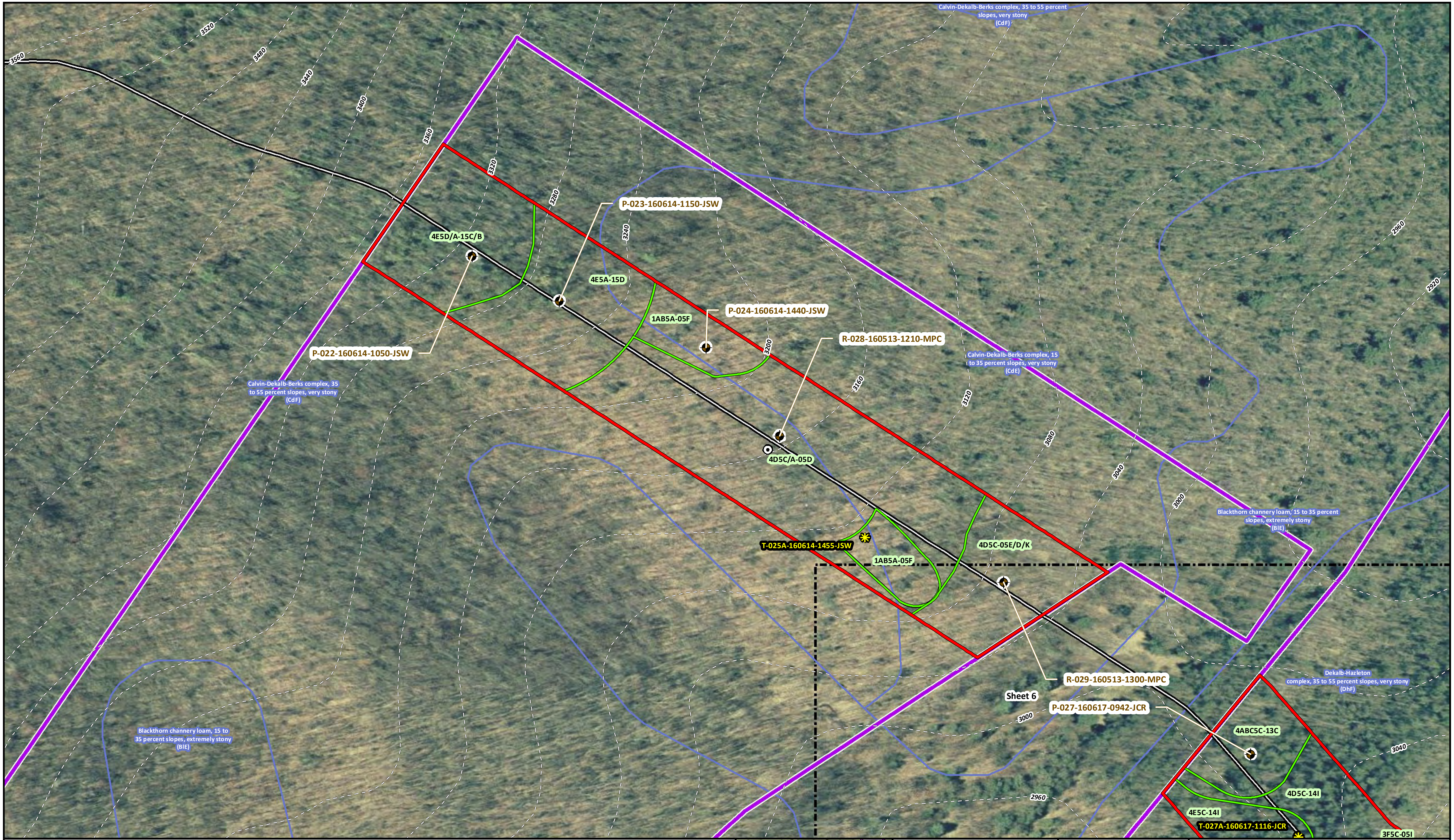
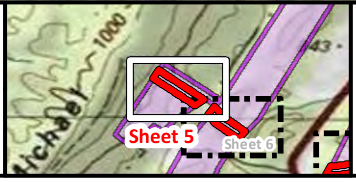


Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attachment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet



0 200 Feet
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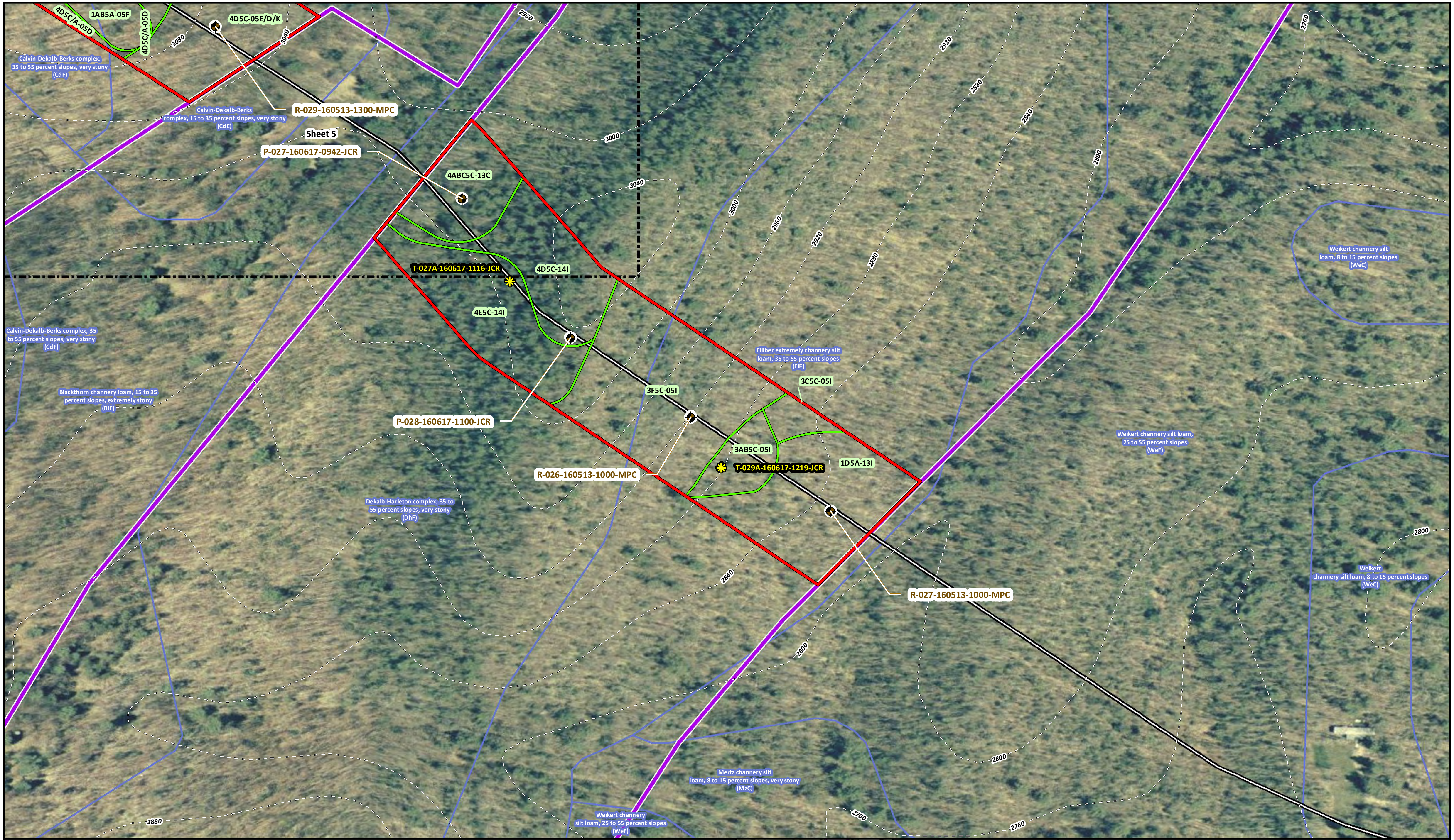

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

Sheet 5
Sheet 6
Sheet 7

0 200 Feet
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Project No. 089962000

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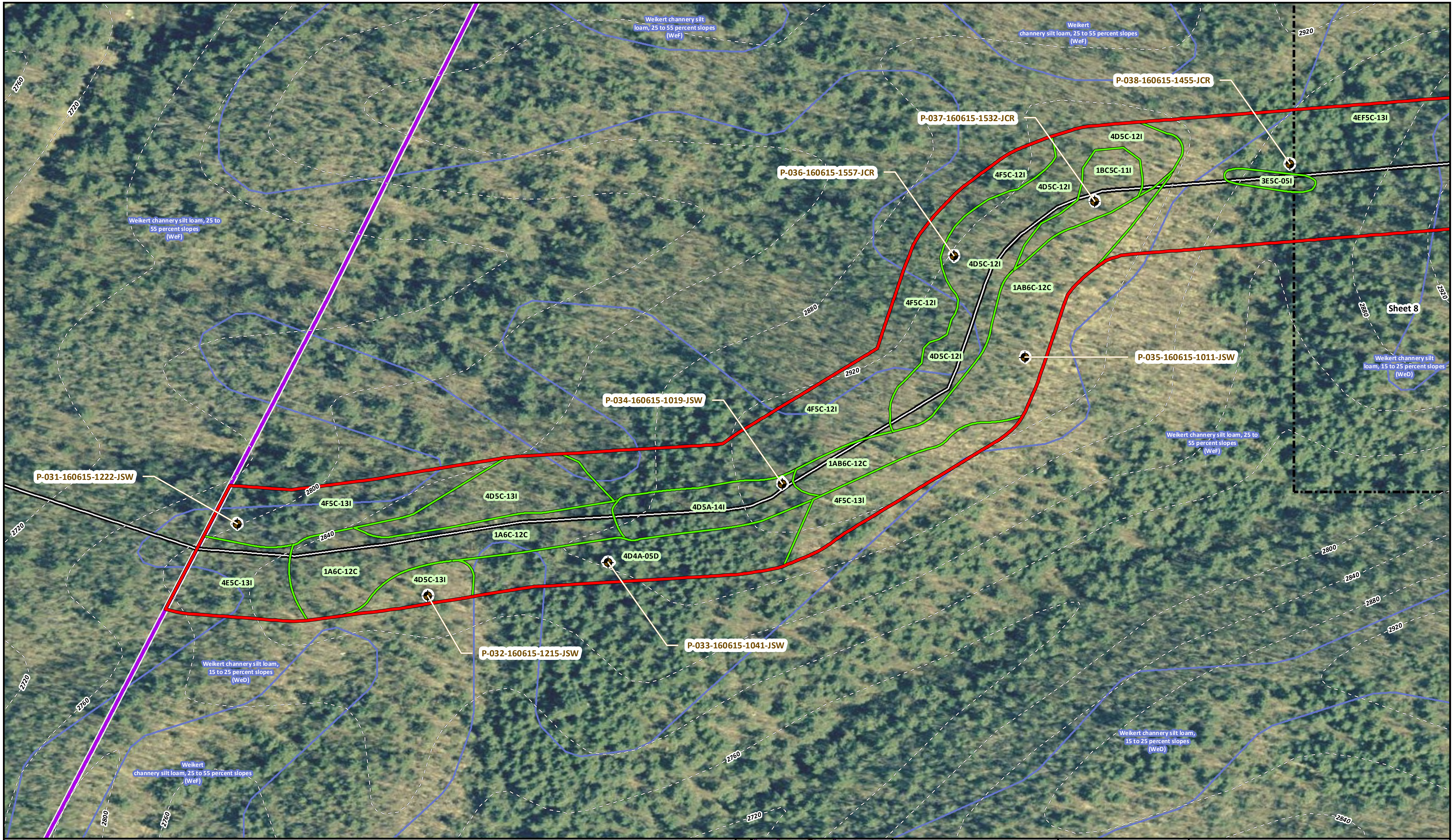

Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest
Mile Post	Spring	Road	Monongahela National Forest

NRCS Soil Unit Boundary

Grid Sheet

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0 200 Feet

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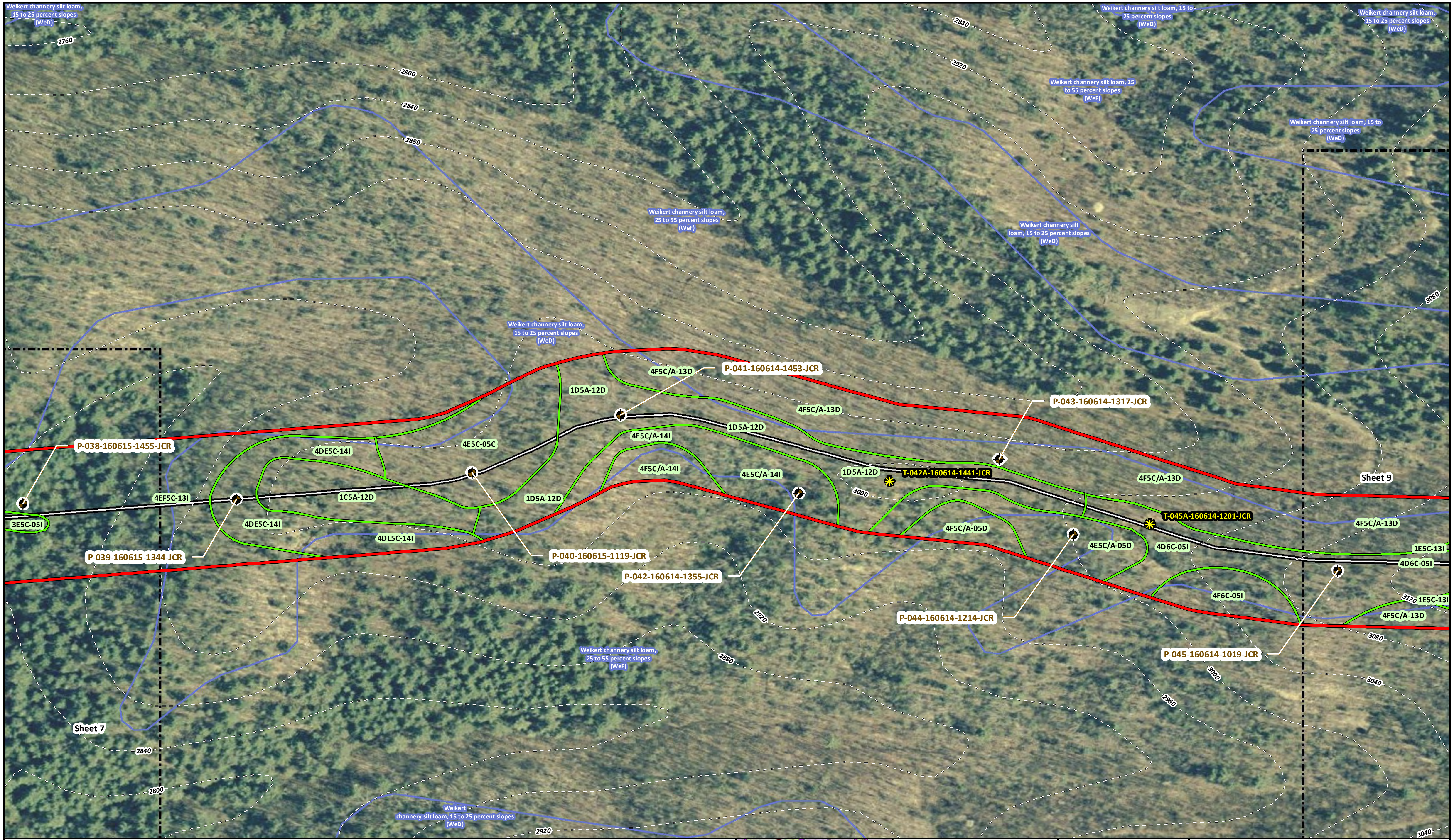

Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation	NRCS Soil Unit Boundary
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)	Grid Sheet
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest	
Mile Post	Spring	Road	Monongahela National Forest	

Sheet 8

0 200 Feet

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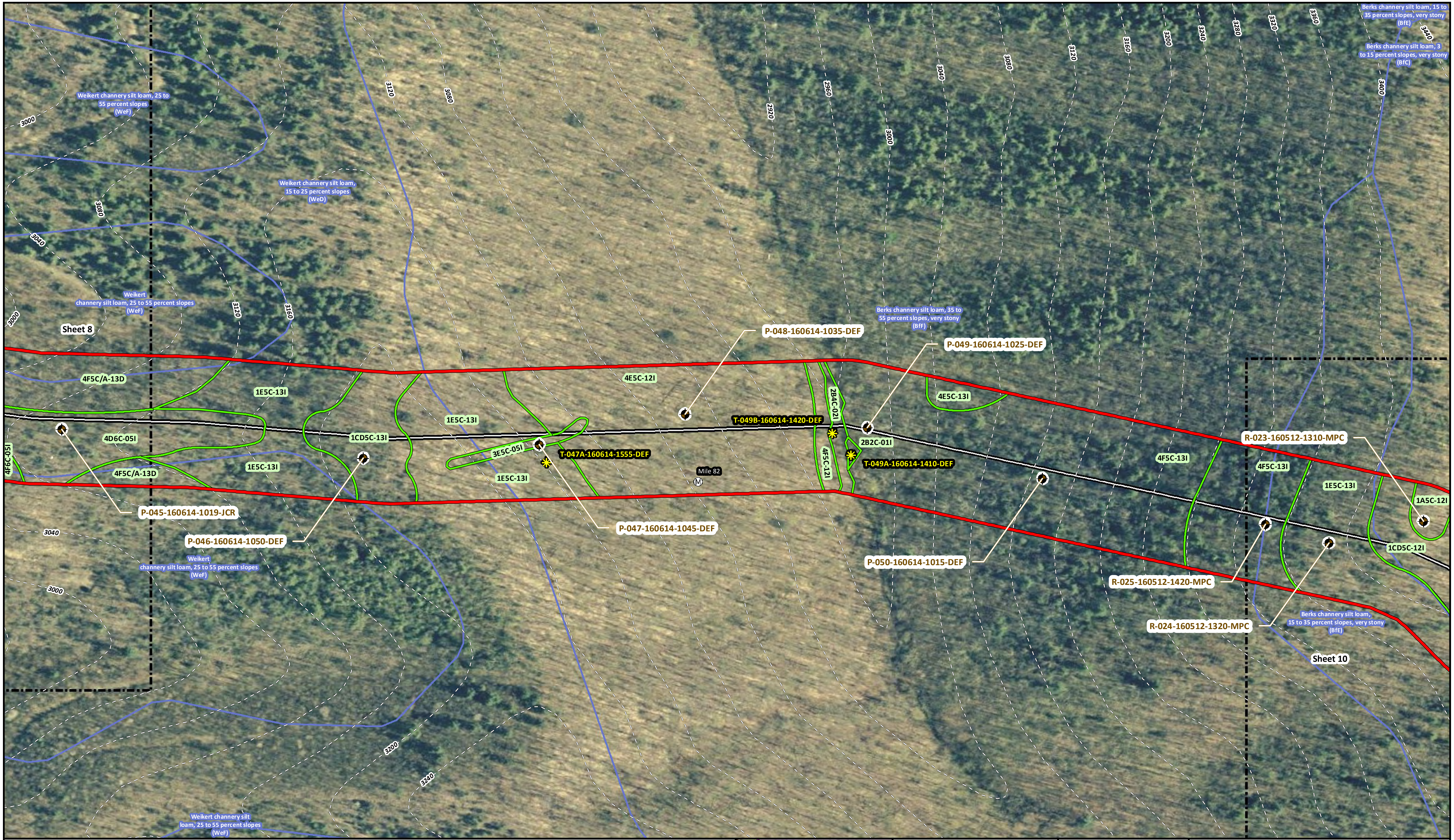
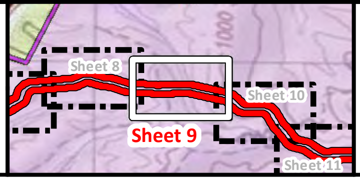


Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet



0 200 Feet
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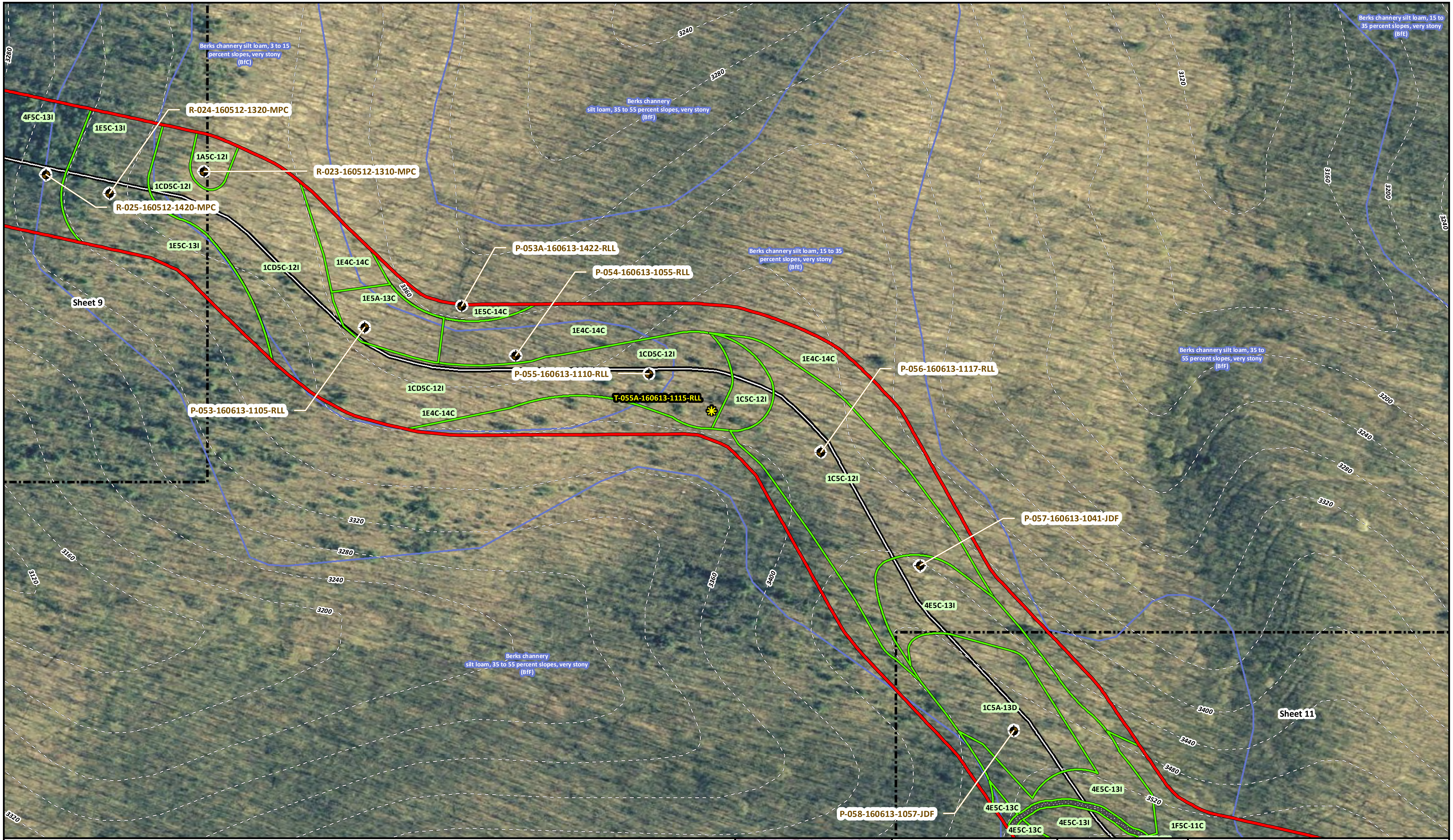

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

Sheet 9
Sheet 10
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Sheet 12

0 200 Feet
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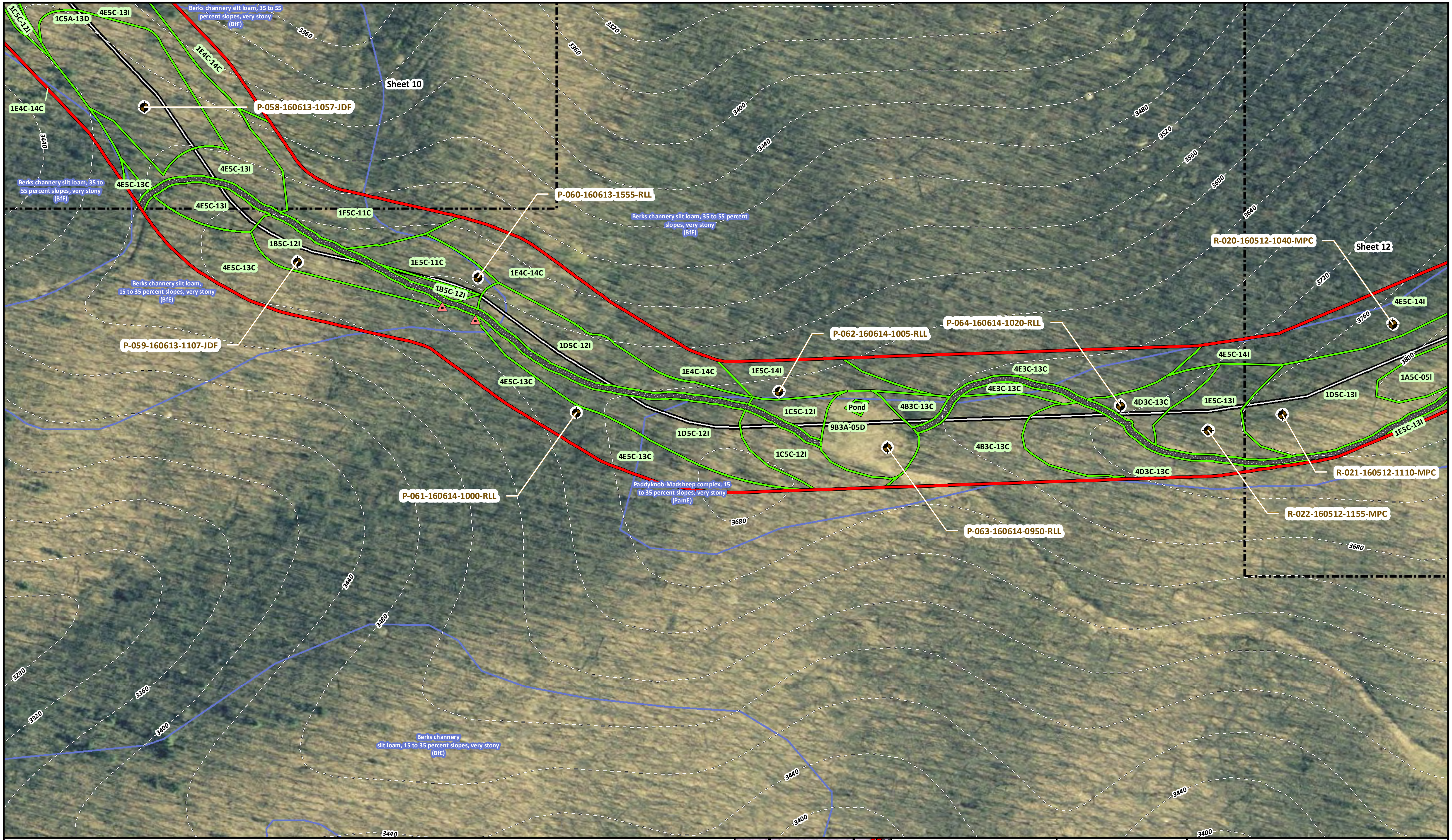

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

Sheet 11

0 200 Feet
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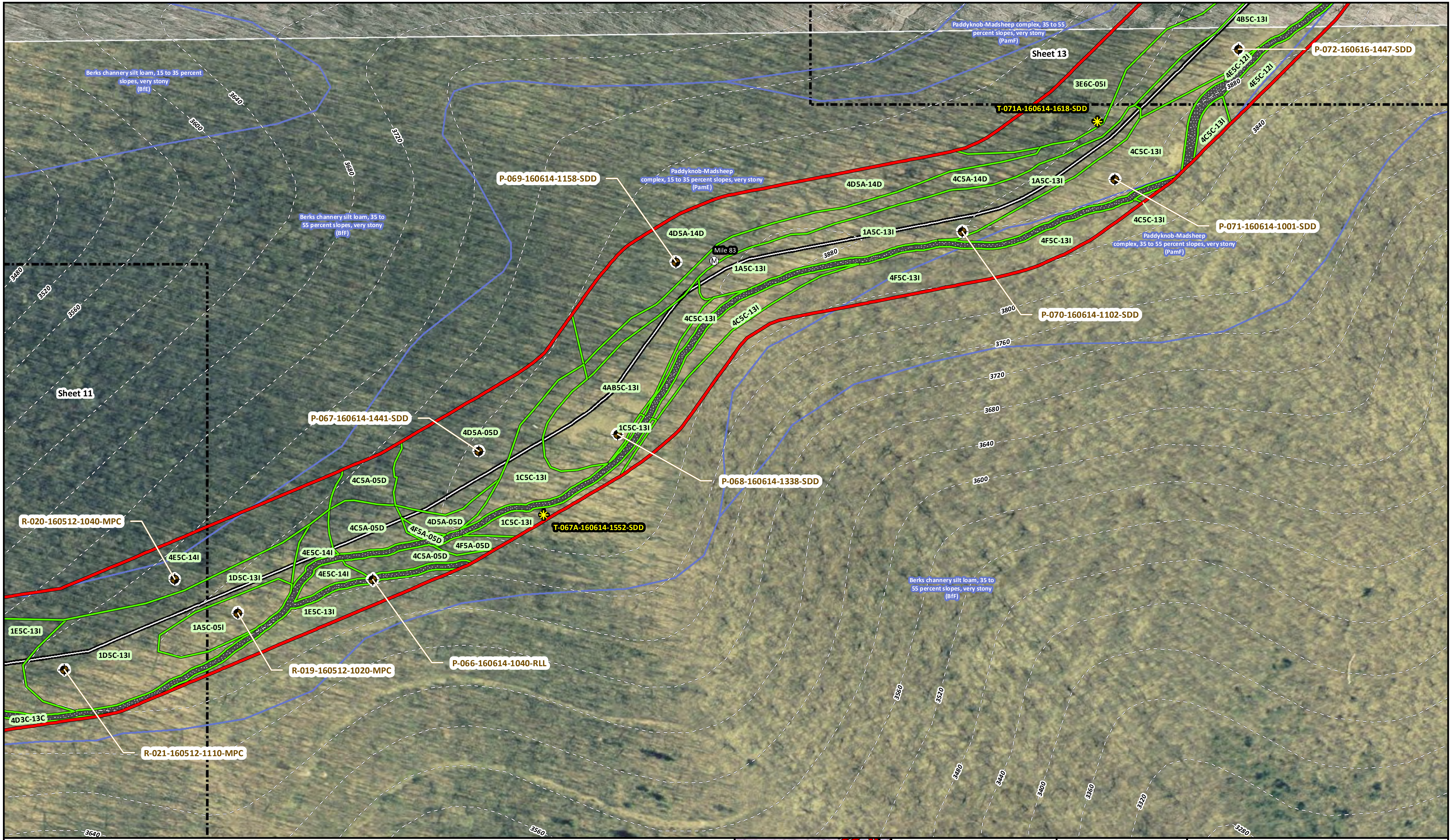
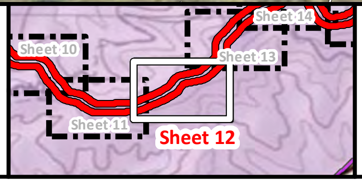


Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation	NRCS Soil Unit Boundary
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)	Grid Sheet
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest	
Mile Post	Spring	Road	Monongahela National Forest	



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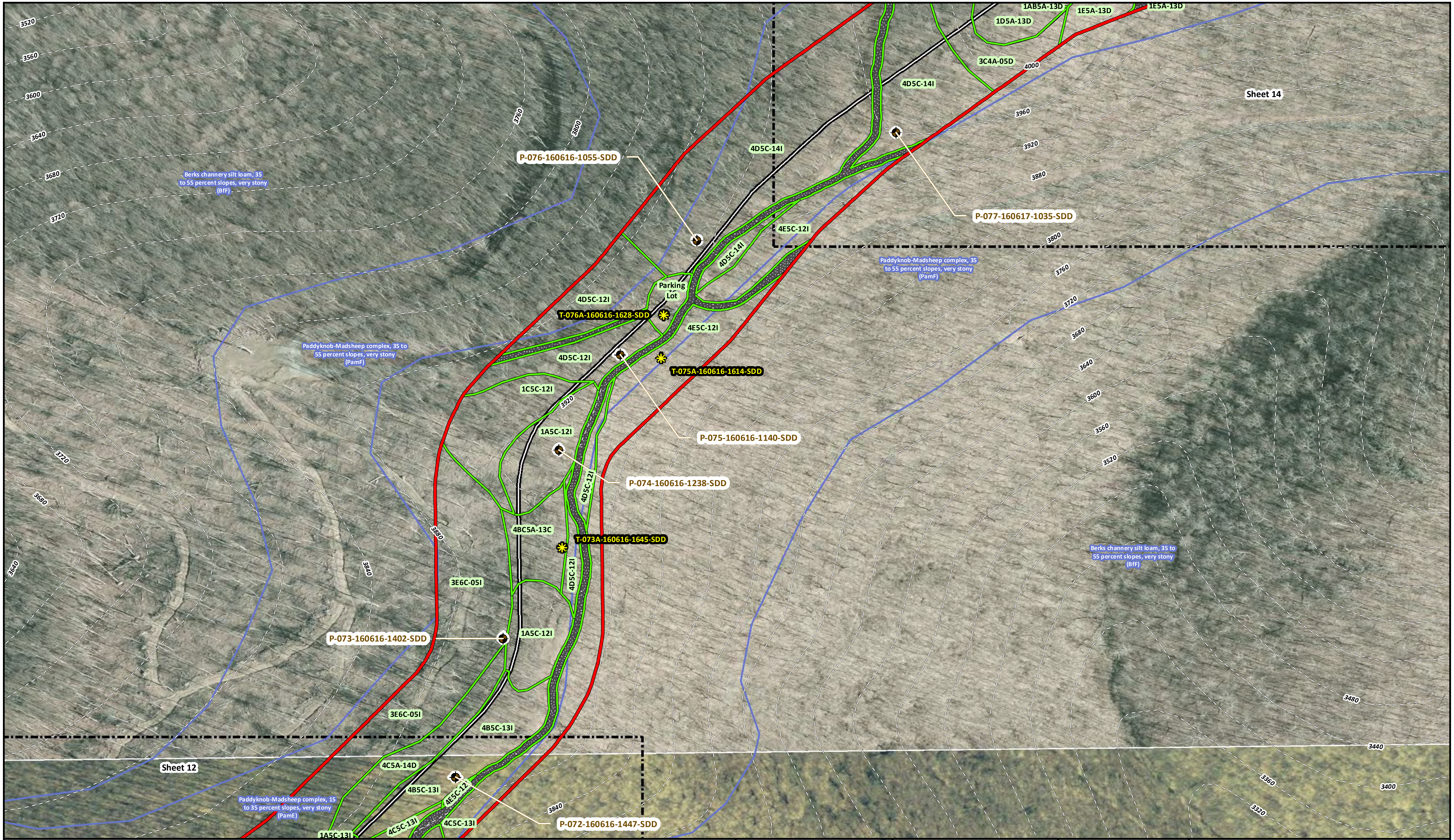
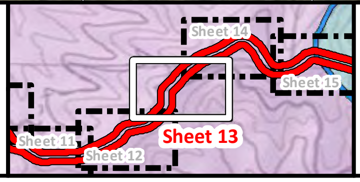


Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet



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Project No. 089962000

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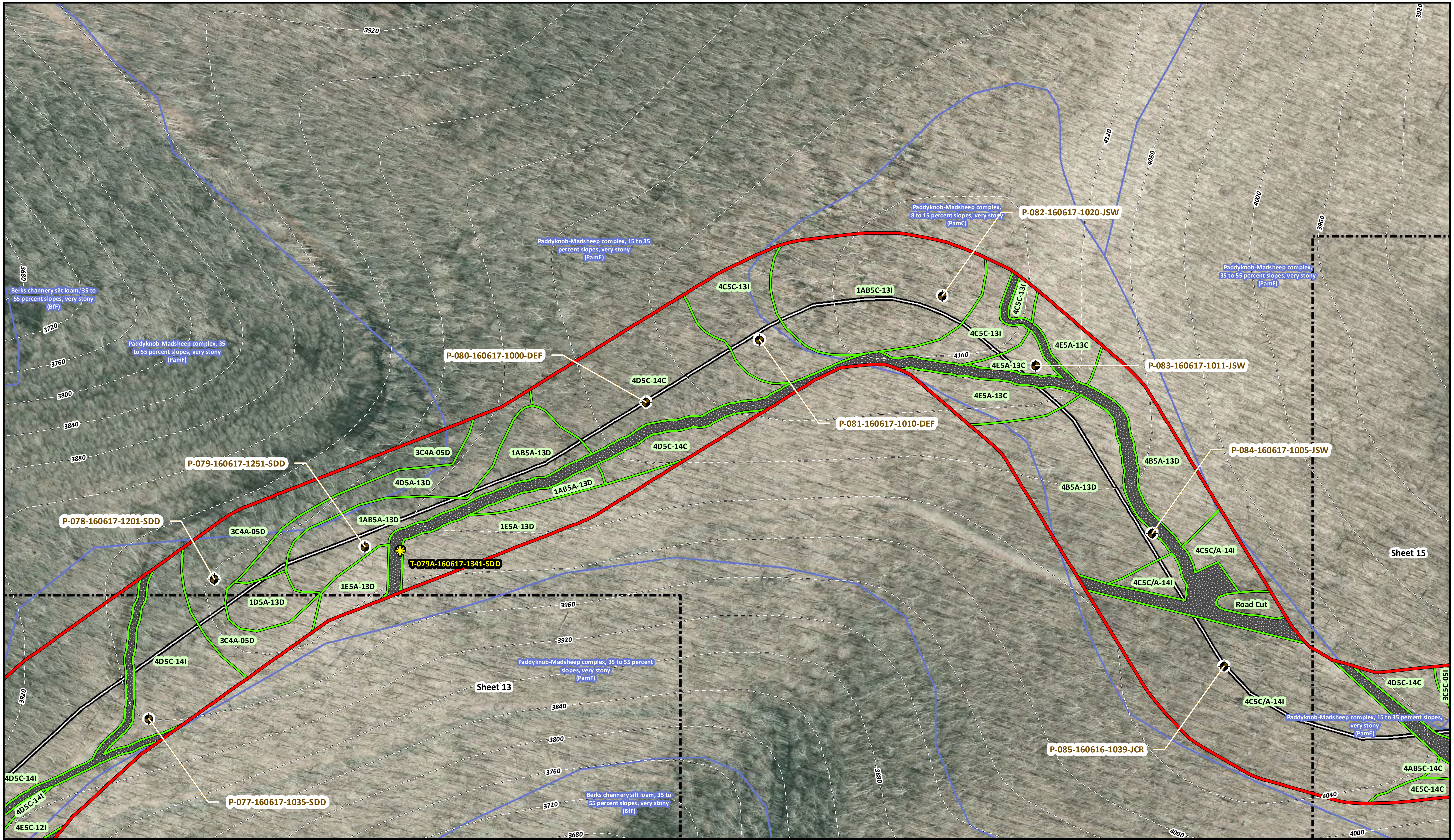

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

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0 200 Feet
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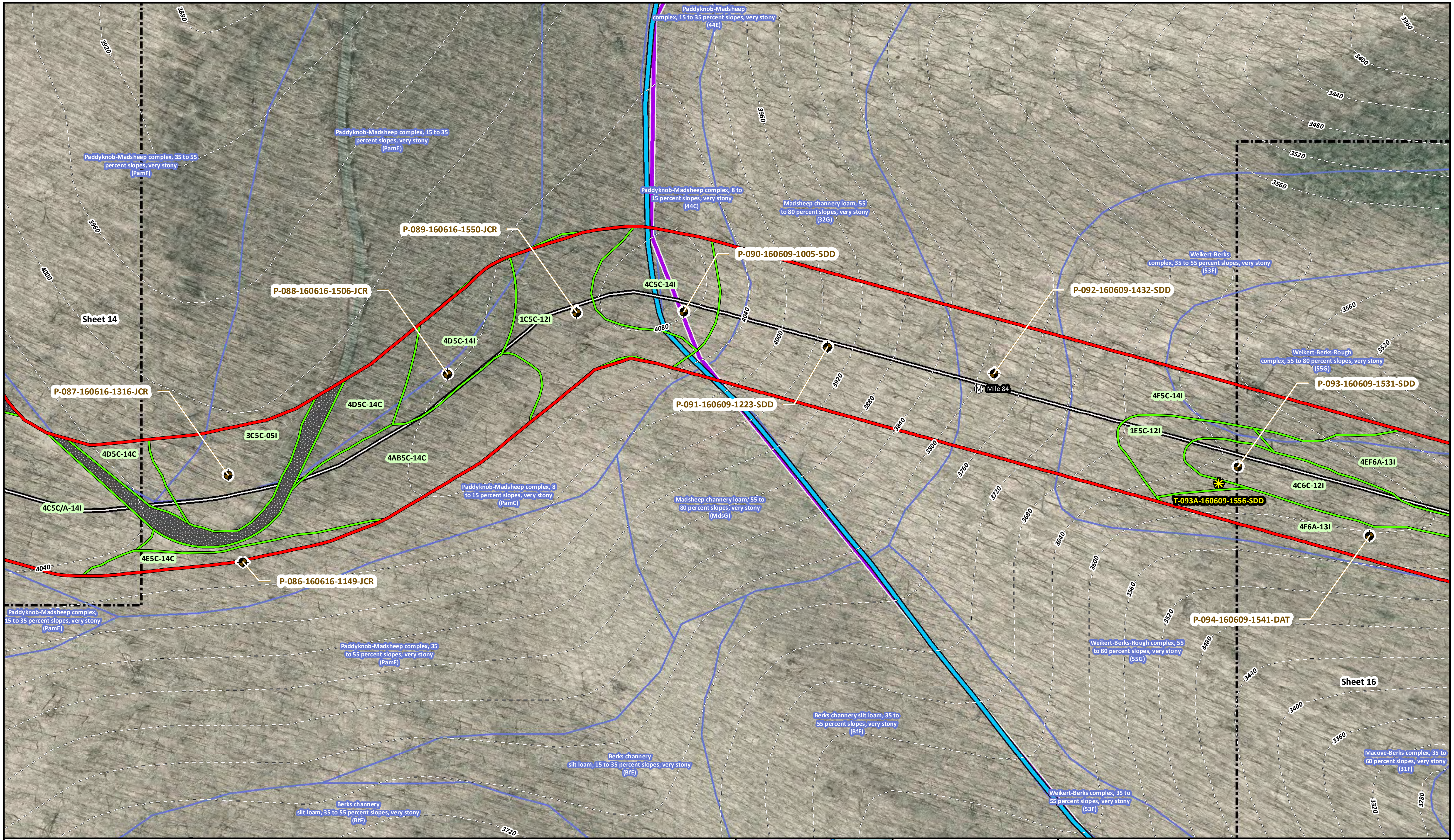

Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest
Mile Post	Spring	Road	Monongahela National Forest

NRCS Soil Unit Boundary
Grid Sheet

Sheet 15

0 — 200 Feet
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Project No. 089962000

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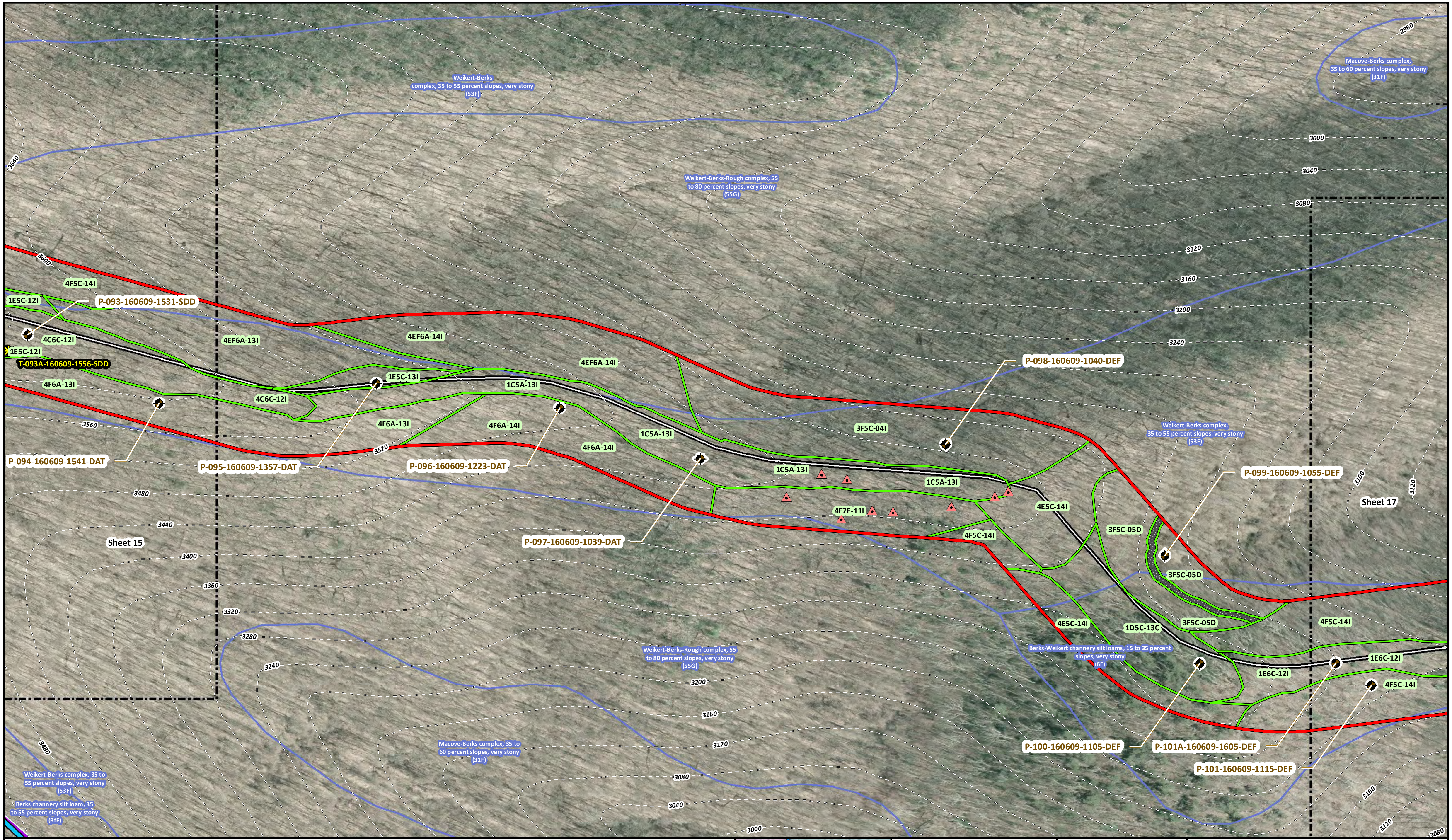

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attachment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

0 200 Feet
1 inch = 200 feet

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Highland County, VA
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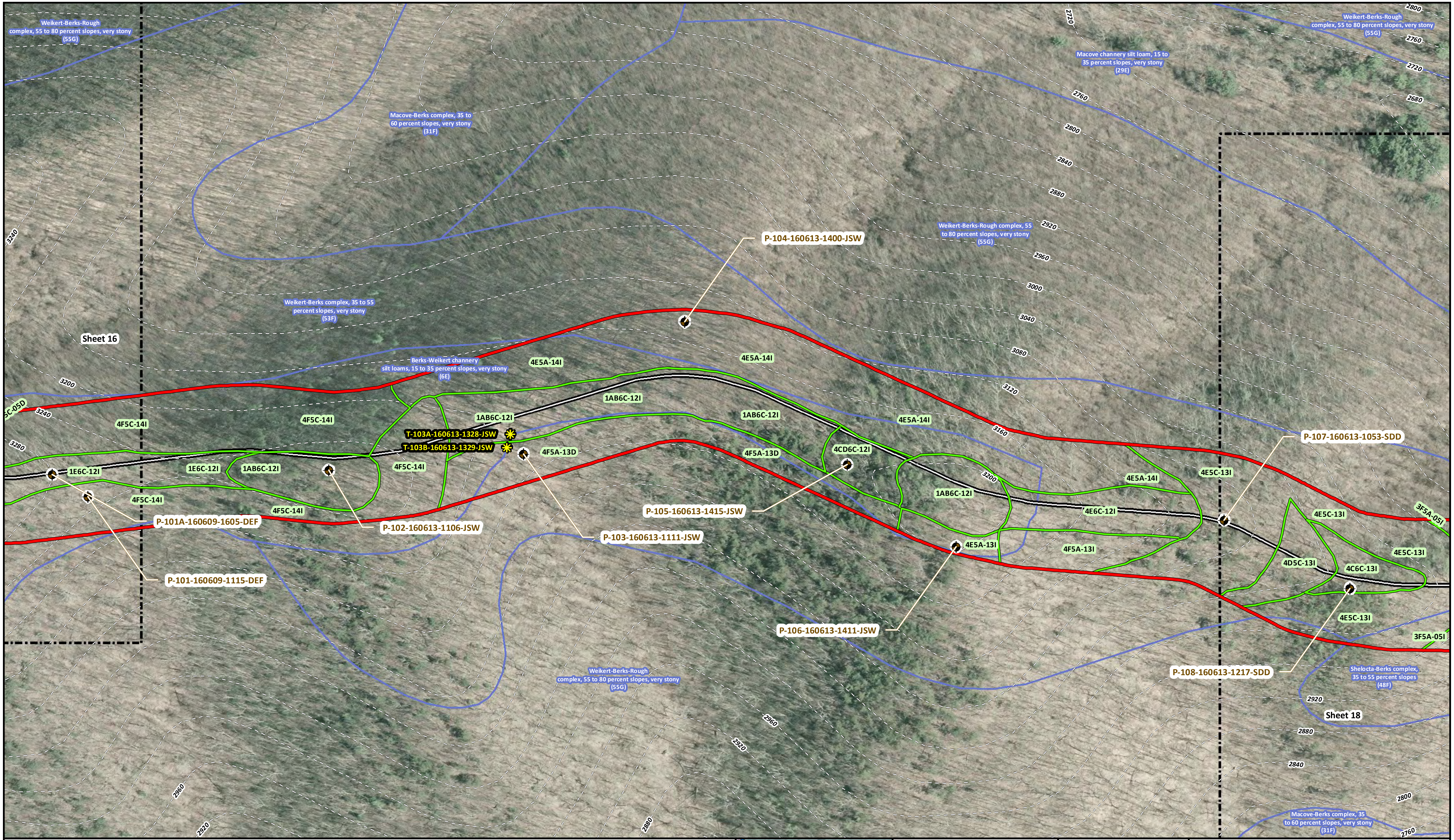

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attachment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

Sheet 17

0 200 Feet
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Highland County, VA
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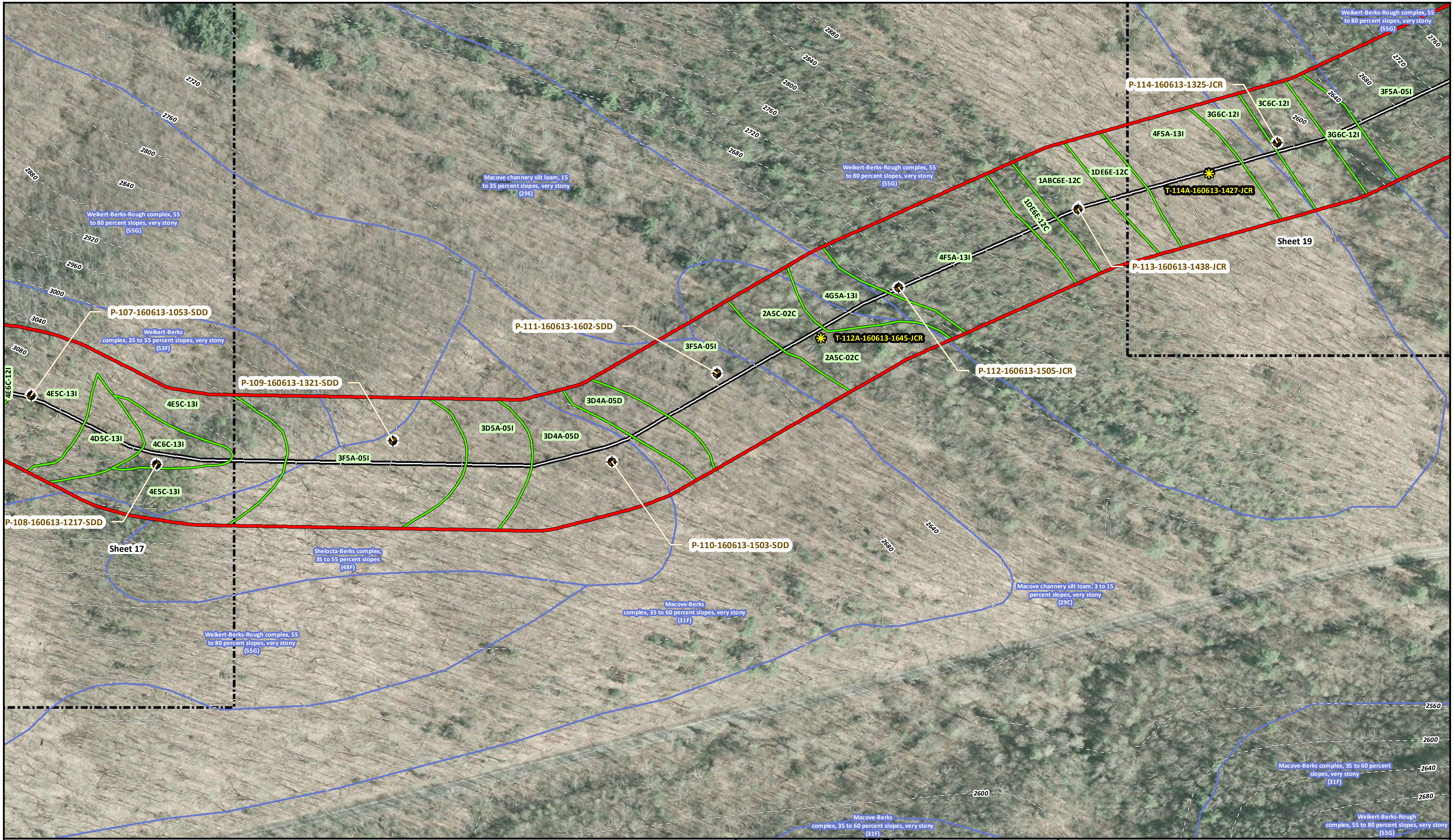

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

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0 200 Feet
1 inch = 200 feet

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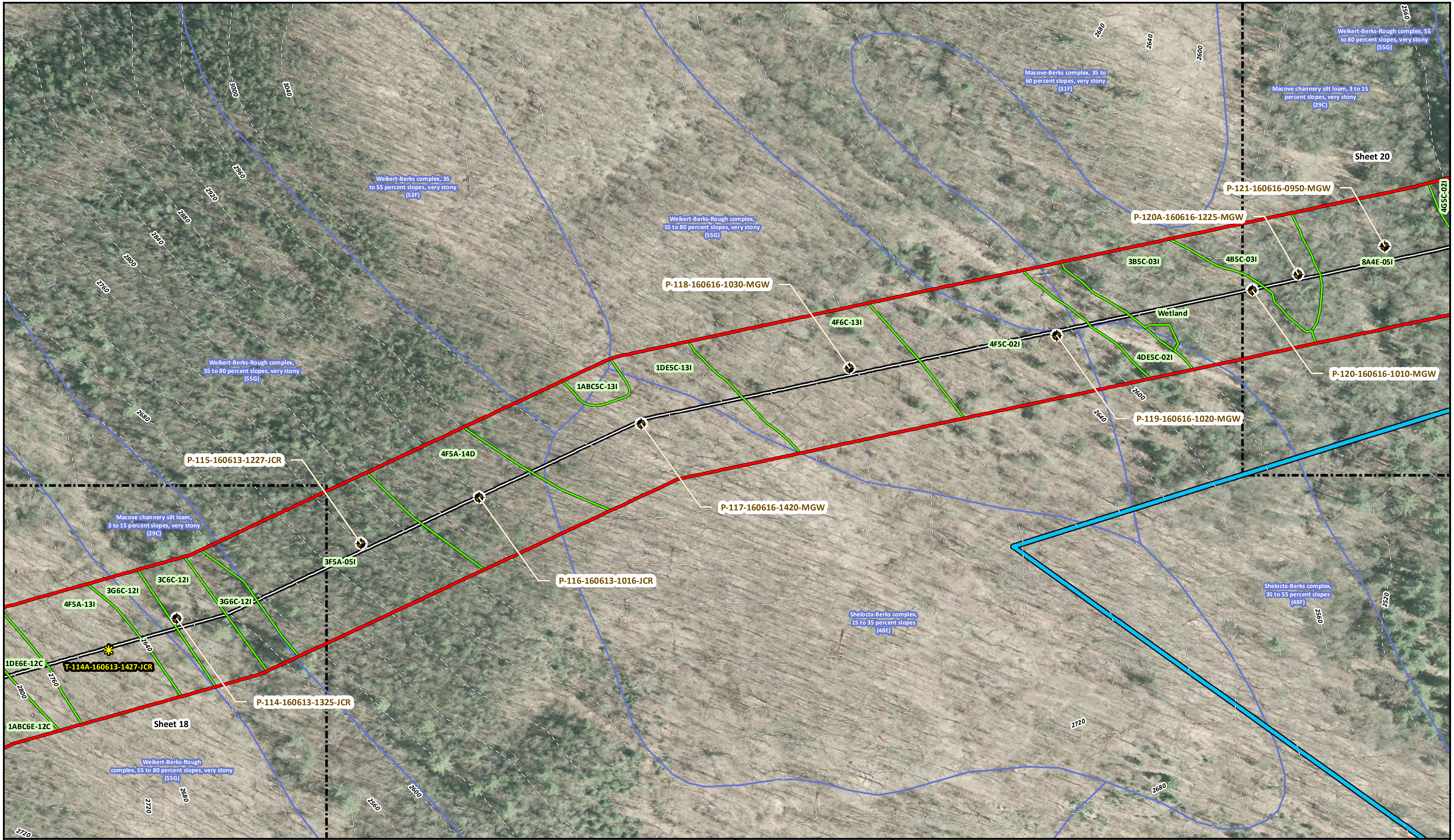

Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation	NRCS Soil Unit Boundary
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)	Grid Sheet
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest	
Mile Post	Spring		Monongahela National Forest	

Sheet 19

0 200 Feet
1 inch = 200 feet

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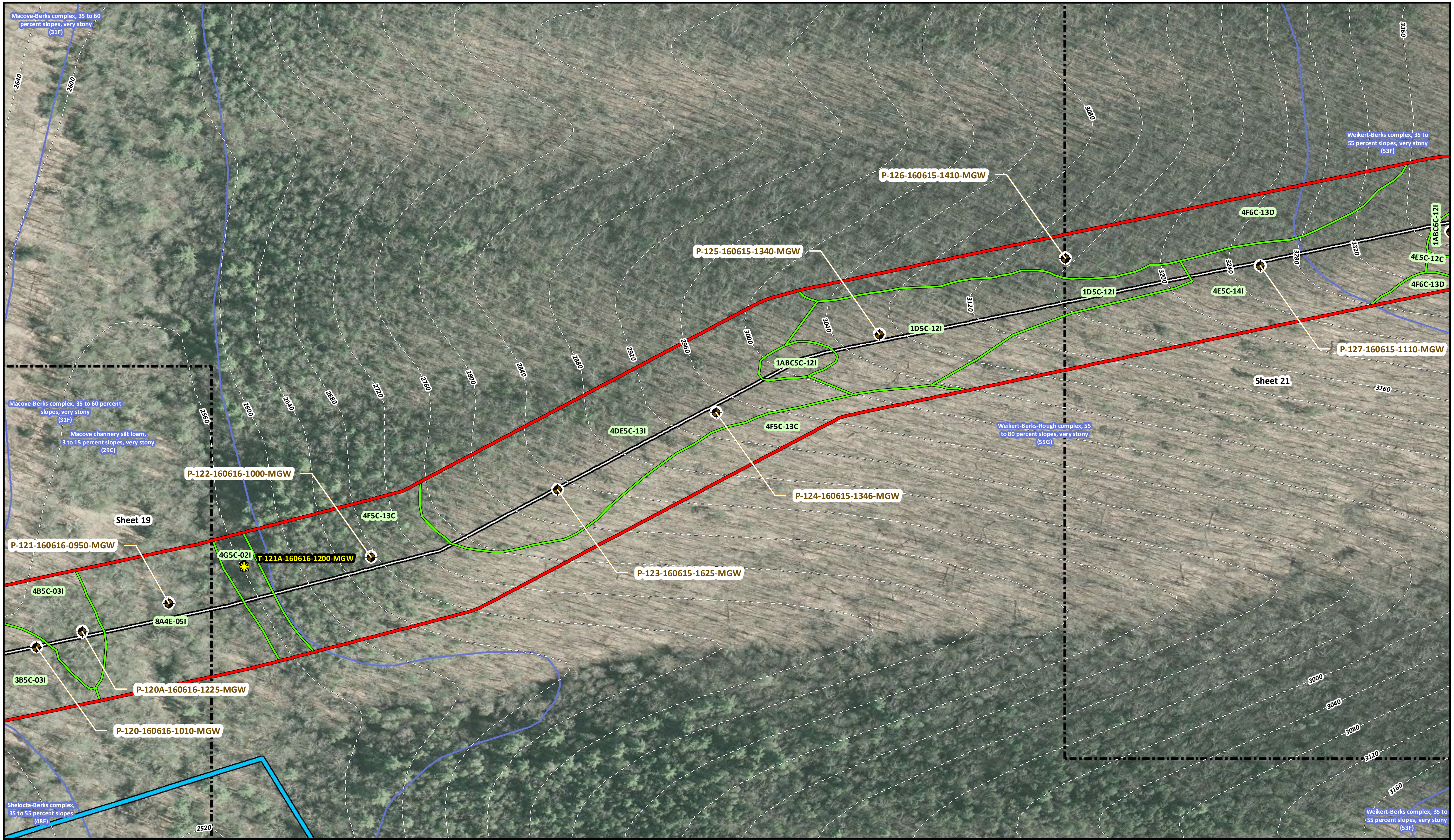

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

0 200 Feet
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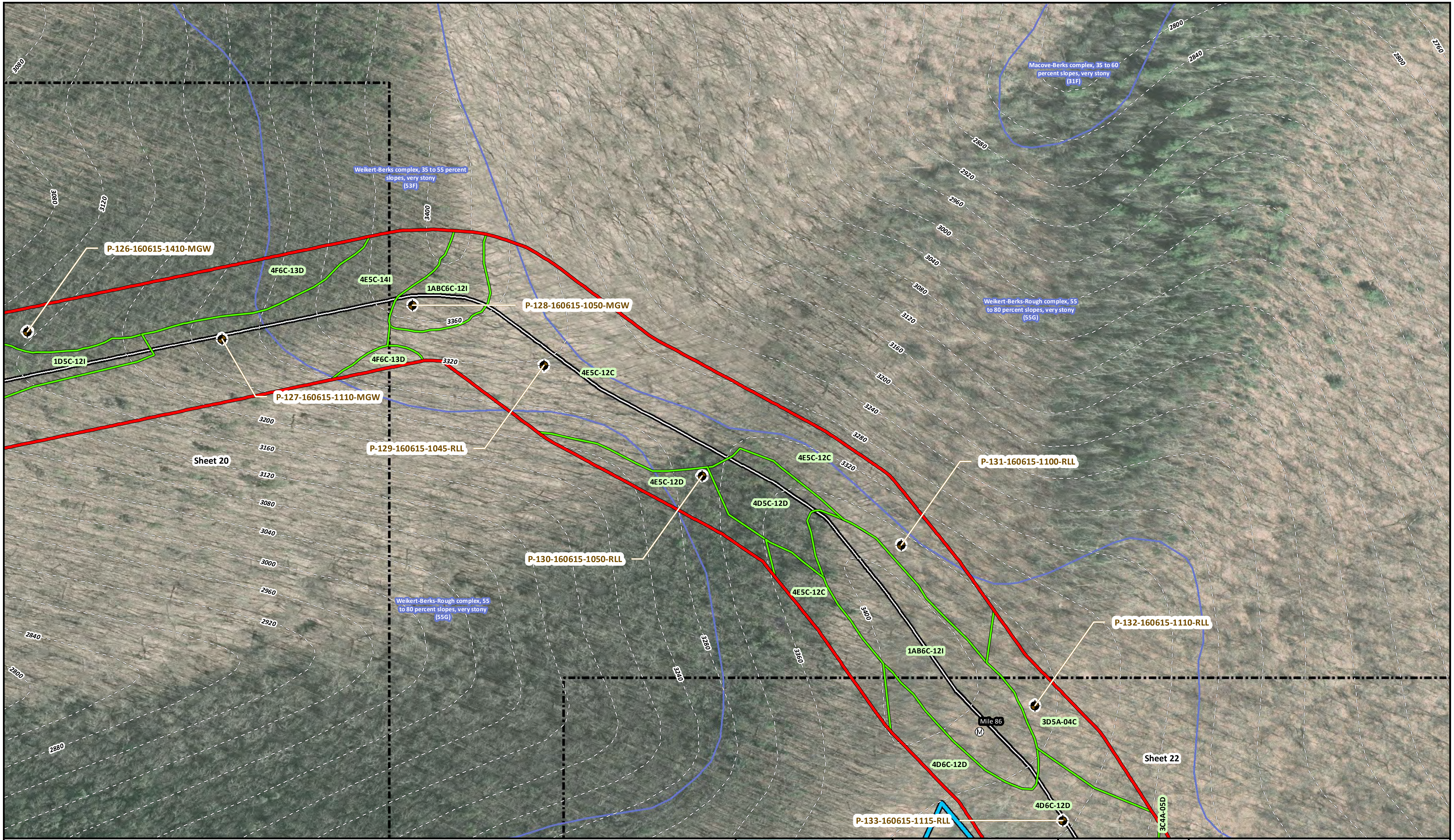

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet

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Sheet 21
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0 200 Feet
1 inch = 200 feet

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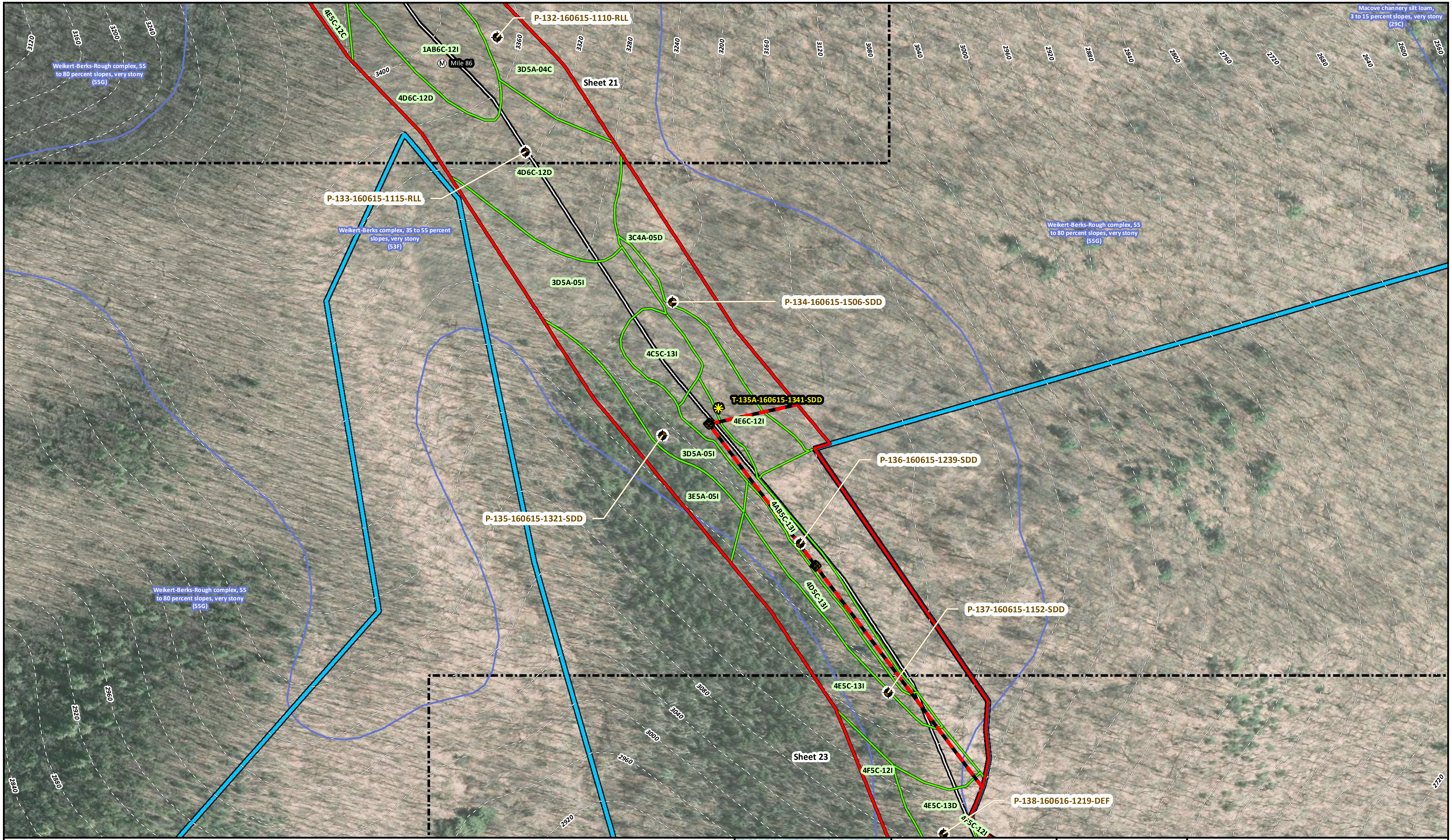

Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation	NRCS Soil Unit Boundary
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)	Grid Sheet
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest	
Mile Post	Spring	Road	Monongahela National Forest	

Sheet 22

0 200 Feet
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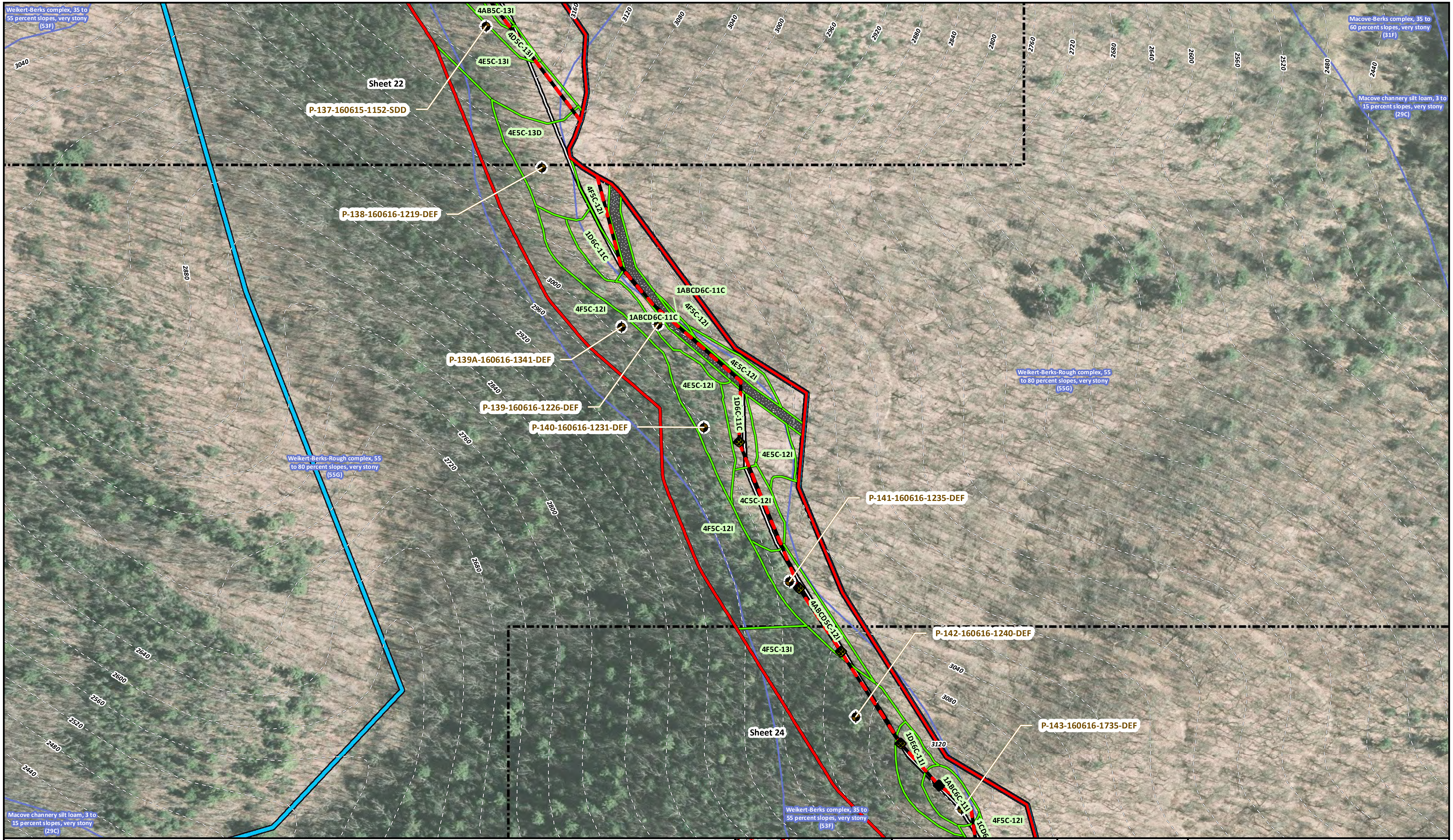

Soil Test Pit	Approximate Property Marker
Proposed Pit Location	Depression
Transect Location	Rock Outcrop
Mile Post	Spring
Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation
Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)
Revised Area of Investigation	George Washington National Forest
Road	Monongahela National Forest
NRCS Soil Unit Boundary	Grid Sheet

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0 200 Feet
1 inch = 200 feet

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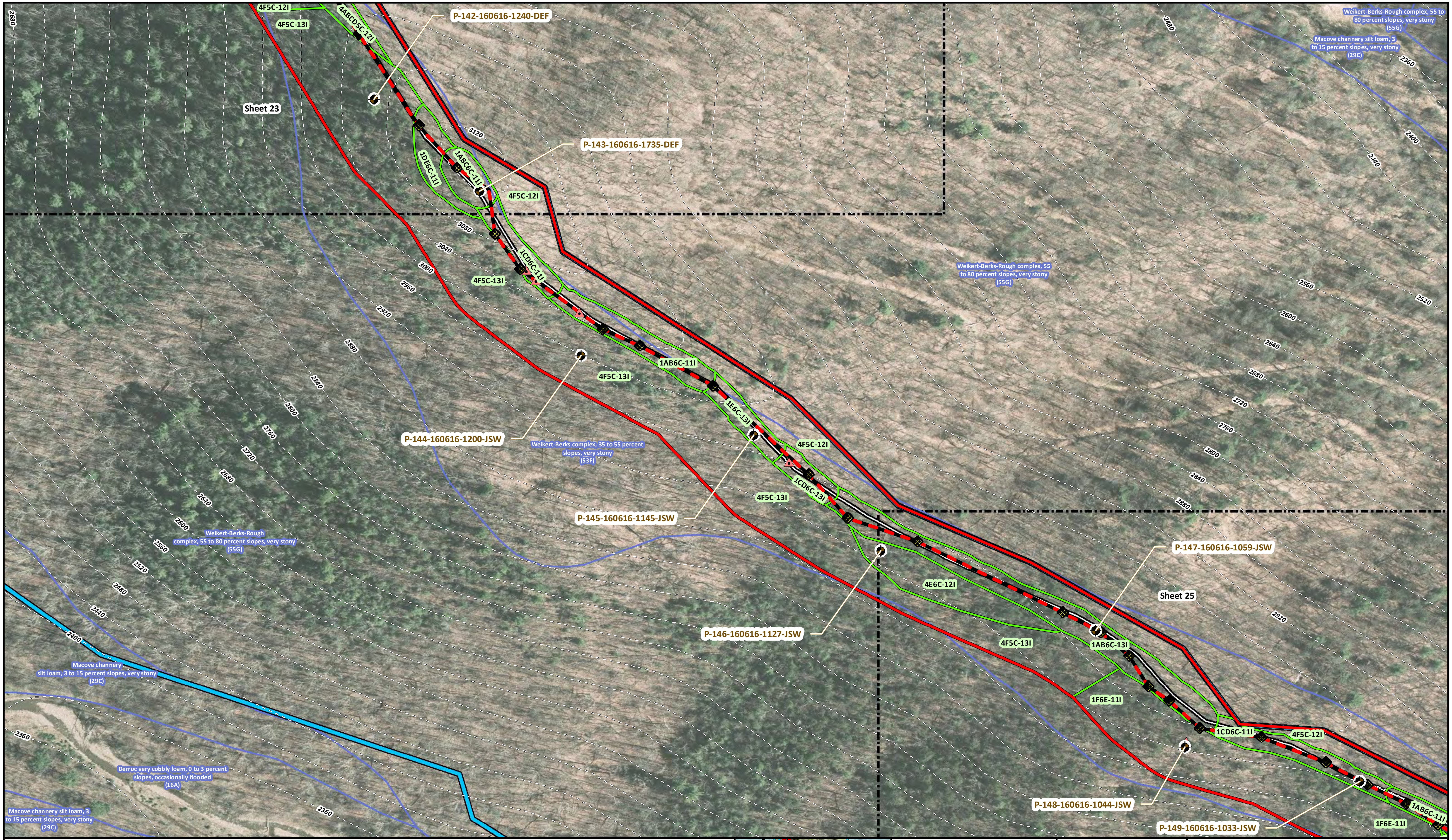

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
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Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
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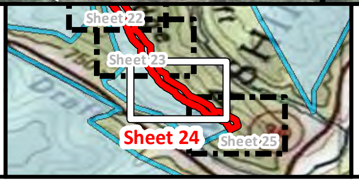

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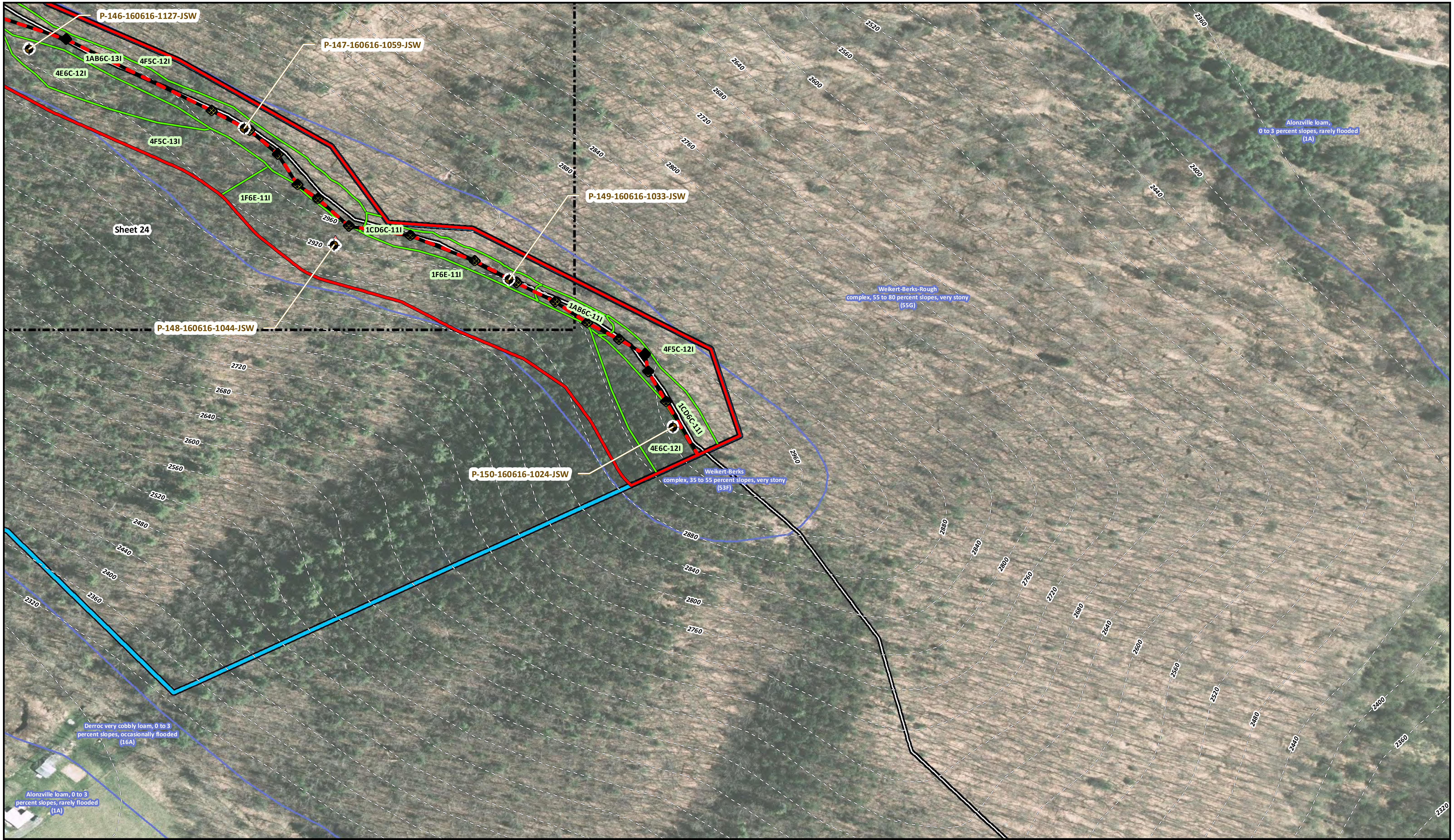
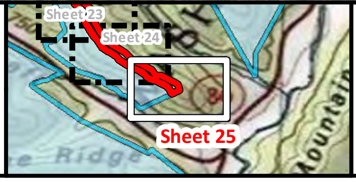


Soil Test Pit	Approximate Property Marker	Centerline Alignment (Rev-10 & Rev-11)	Area of Investigation	NRCS Soil Unit Boundary
Proposed Pit Location	Depression	Elevation Contour (40' Interval)	Soil Unit Boundary (ID Key in Attchment 6)	Grid Sheet
Transect Location	Rock Outcrop	Revised Area of Investigation	George Washington National Forest	
Mile Post	Spring	Road	Monongahela National Forest	



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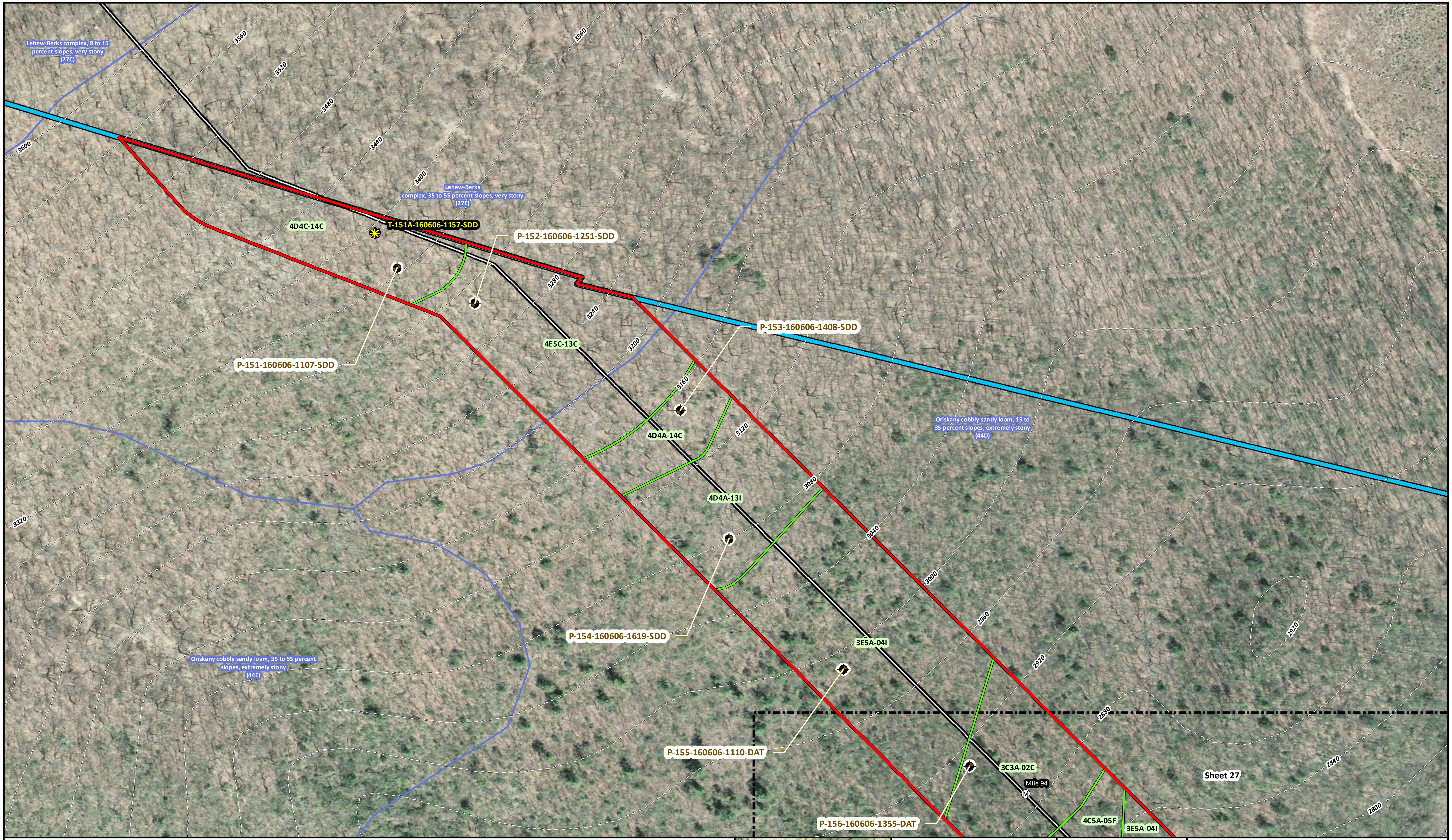

Soil Test Pit
Proposed Pit Location
Transect Location
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Soil Unit Boundary (ID Key in Attchment 6)
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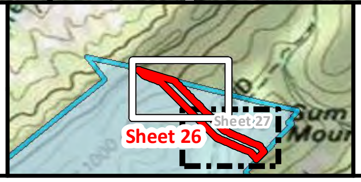

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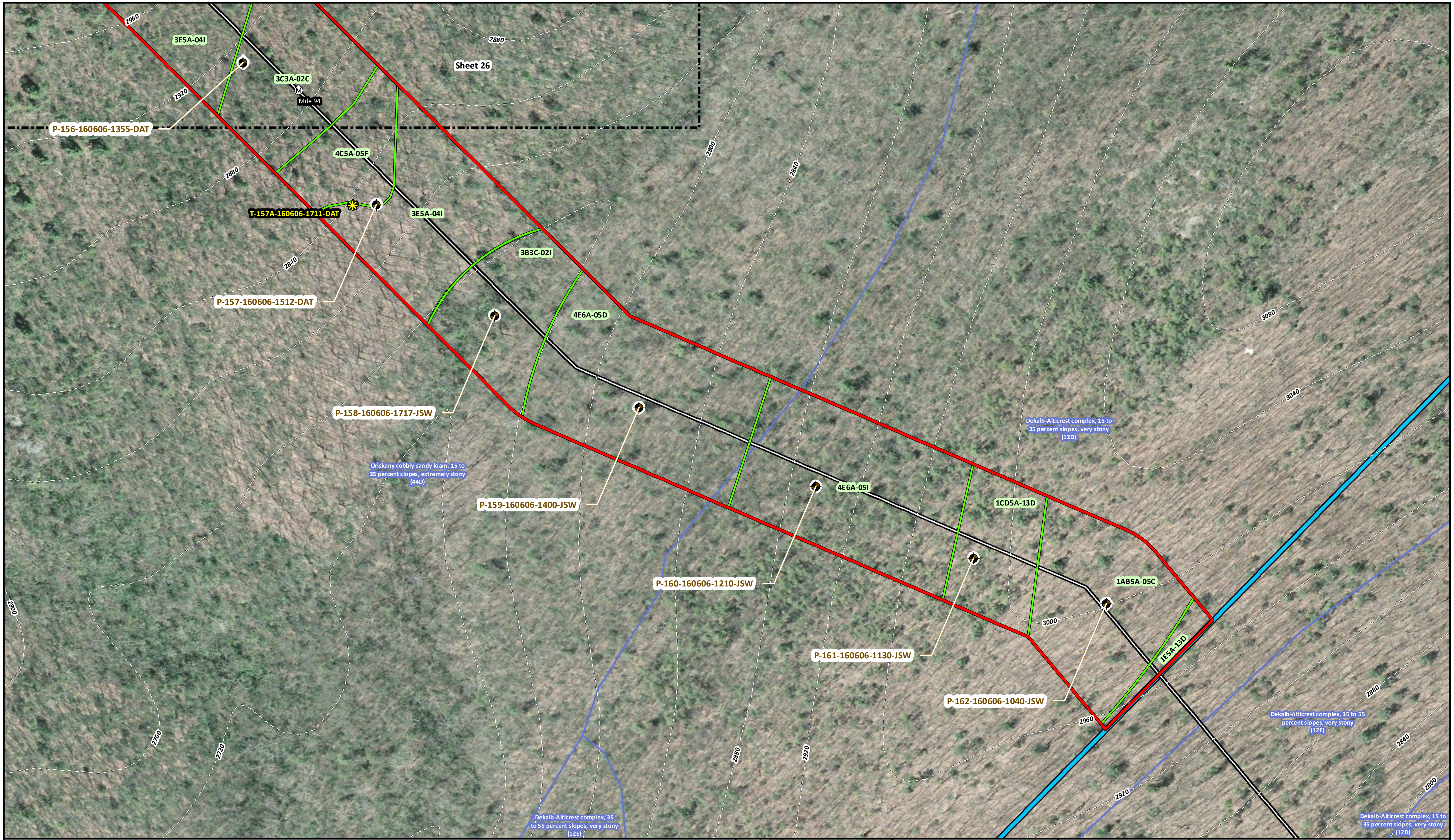

Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
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Soil Unit Boundary (ID Key in Attchment 6)
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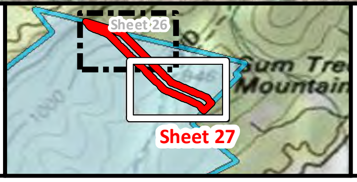

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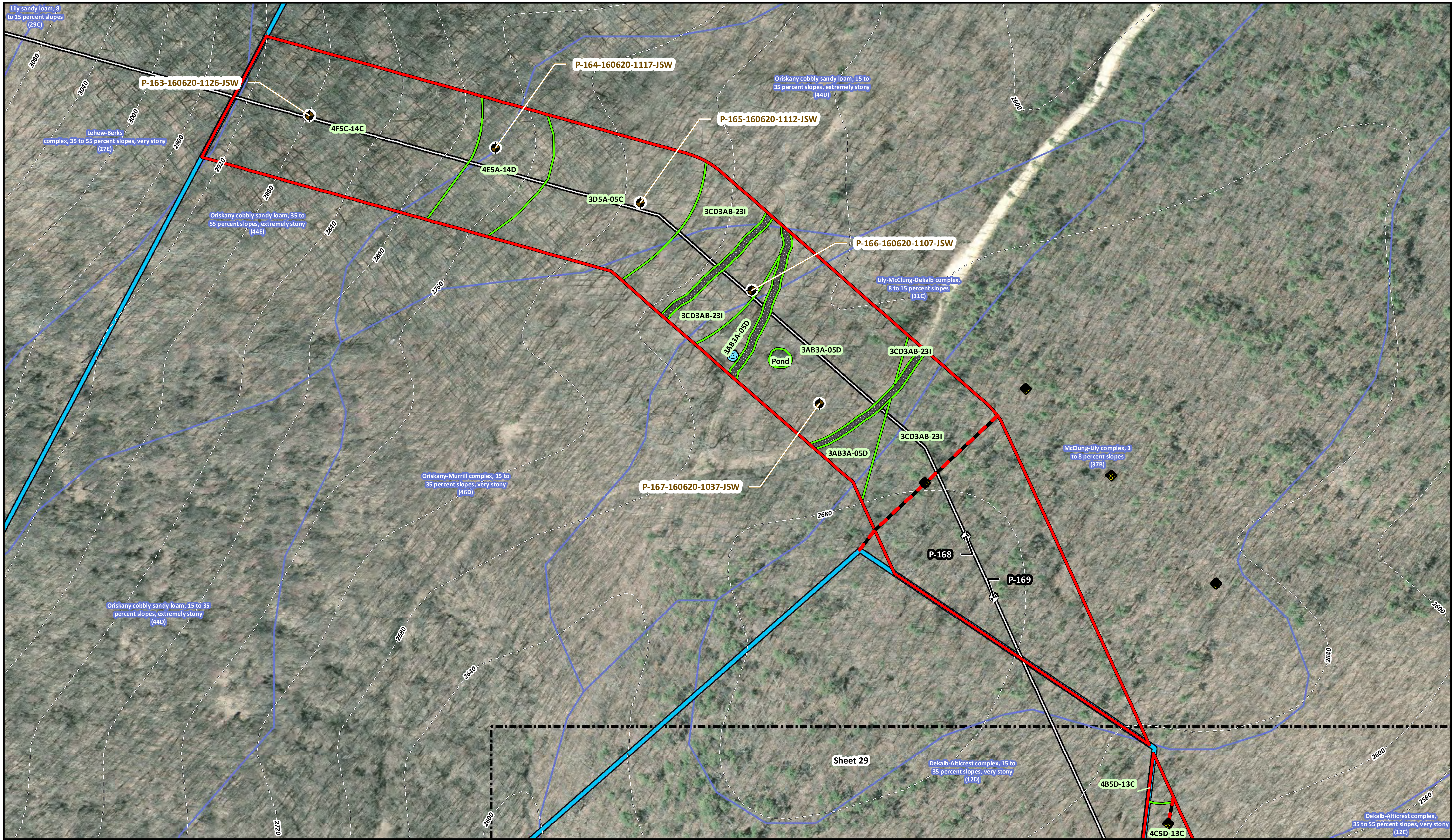

Soil Test Pit
Proposed Pit Location
Transect Location
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Soil Unit Boundary (ID Key in Attchment 6)
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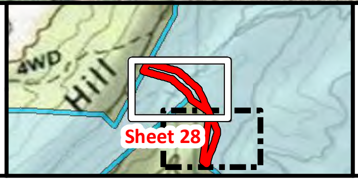

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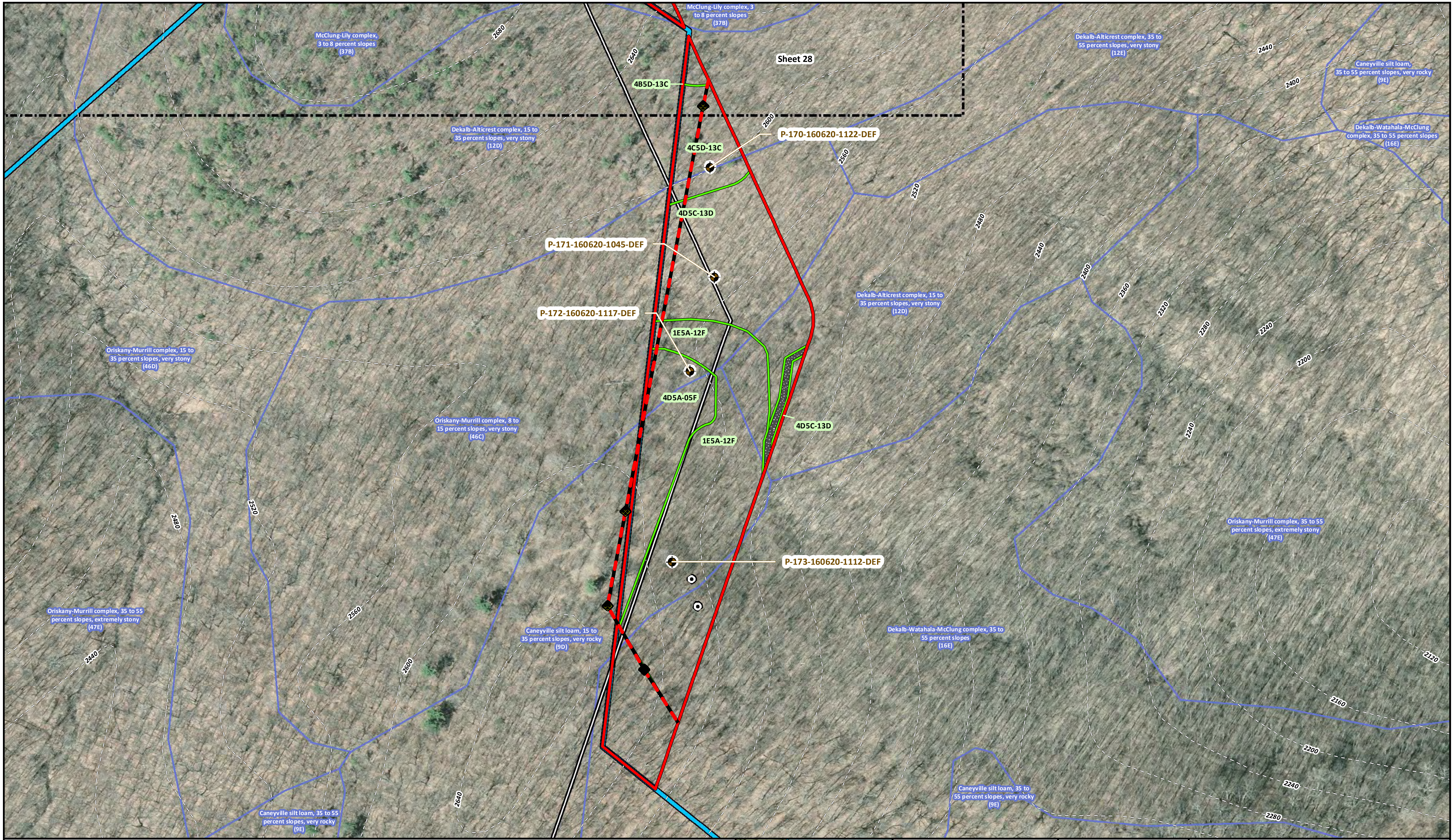

Soil Test Pit
Proposed Pit Location
Transect Location
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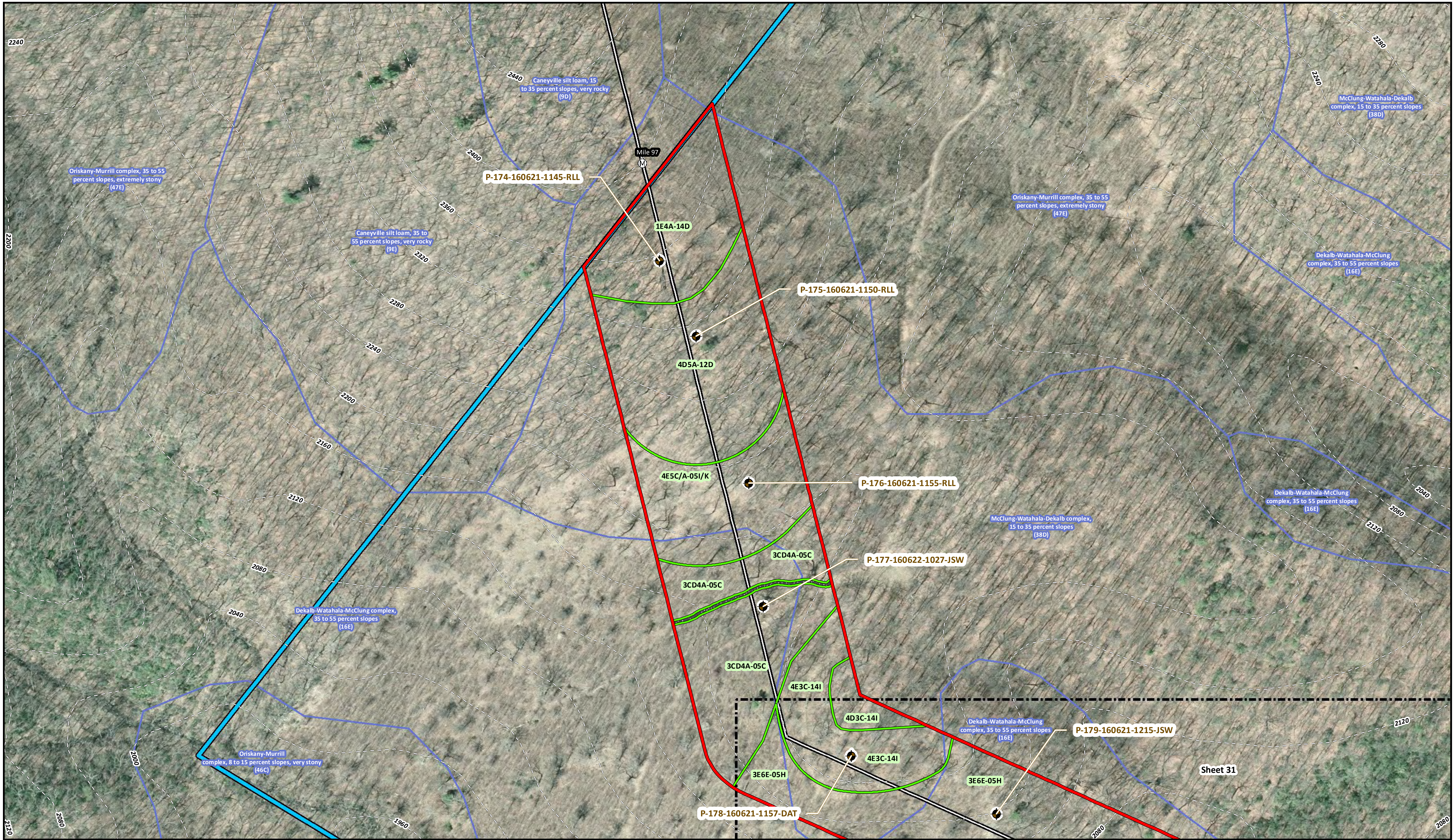

Soil Test Pit
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0 200 Feet
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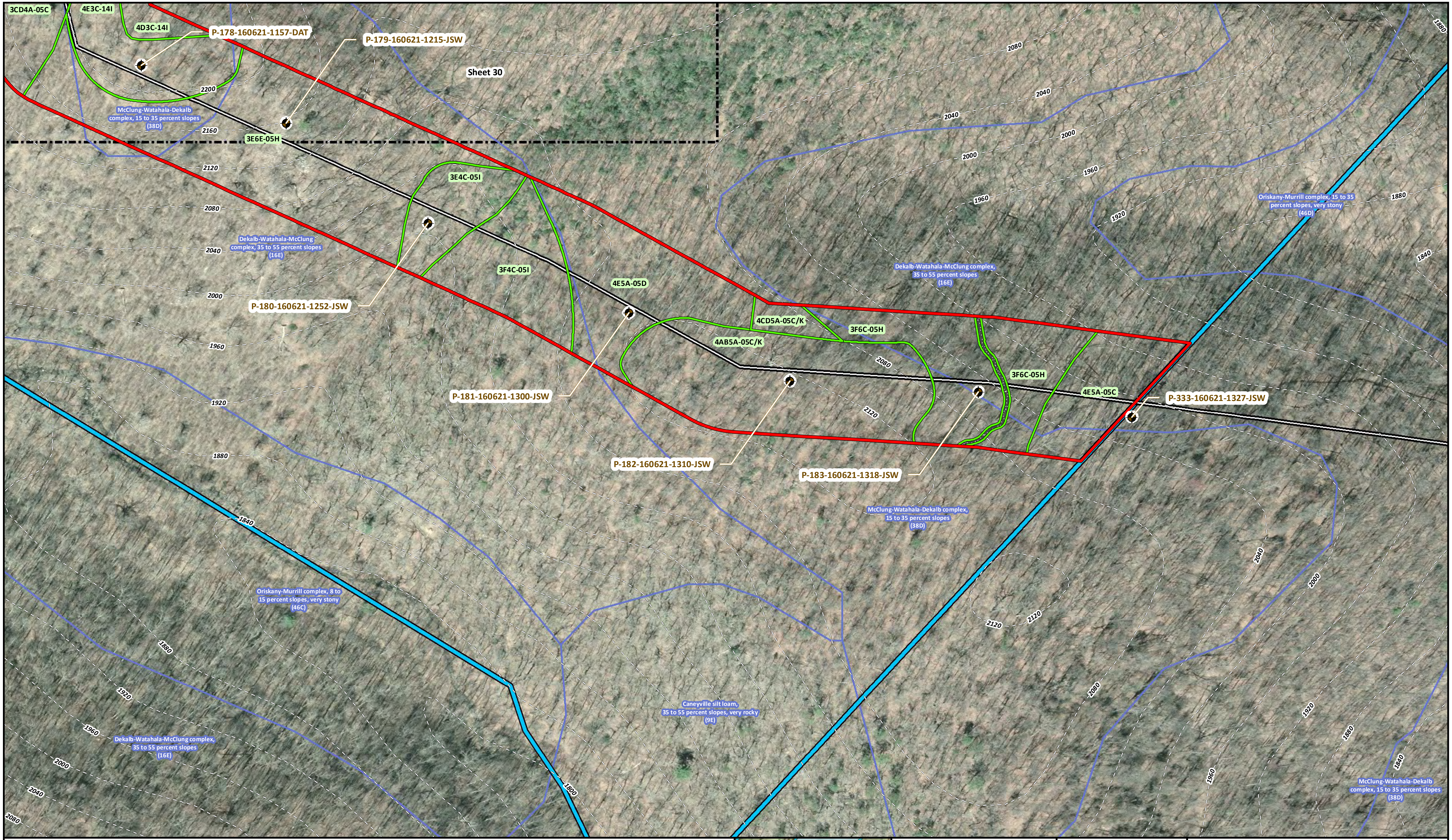

- Soil Test Pit
- Proposed Pit Location
- Transect Location
- Mile Post
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- Area of Investigation
- Soil Unit Boundary (ID Key in Attchment 6)
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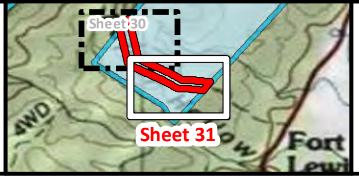

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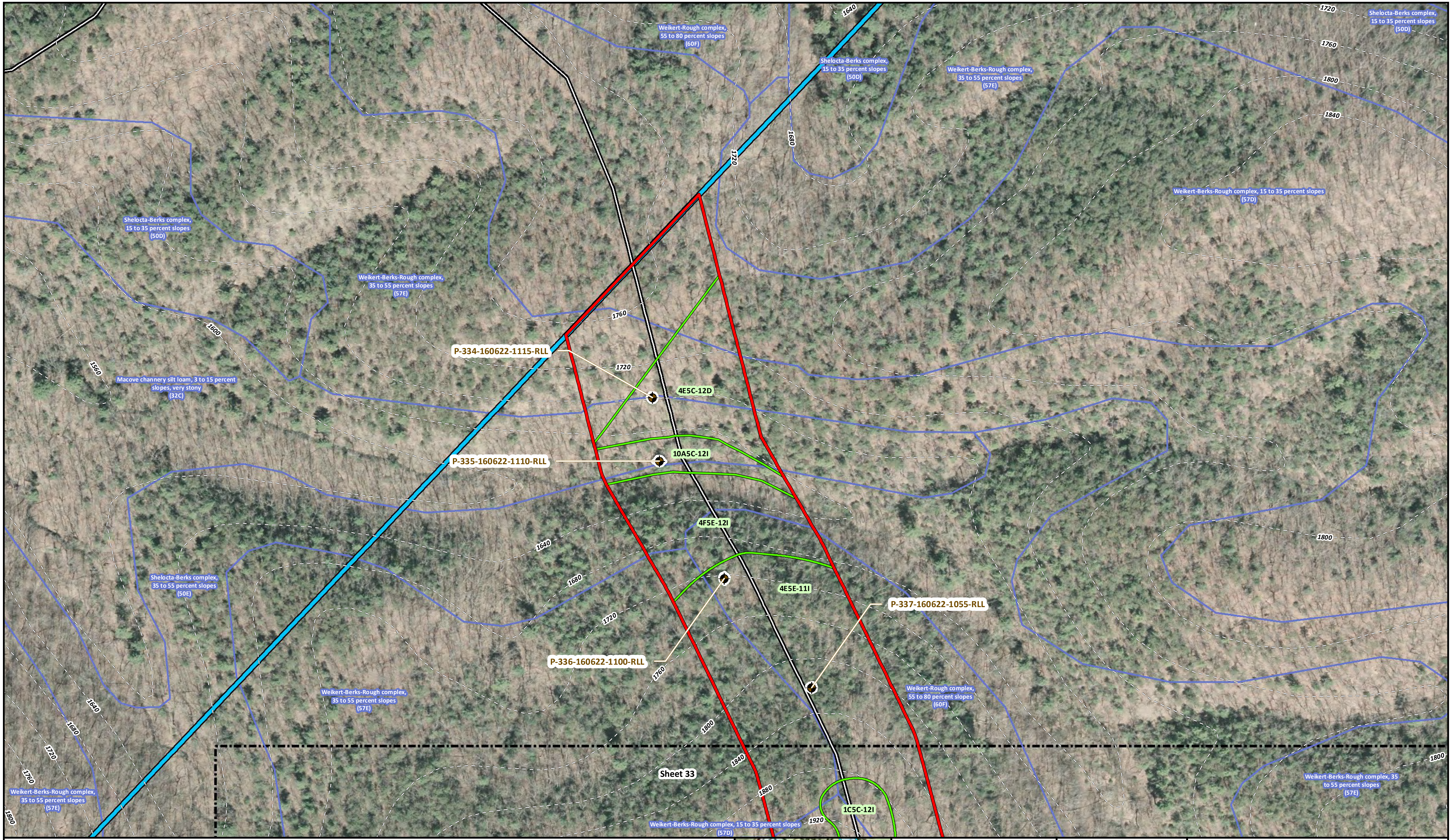

Soil Test Pit
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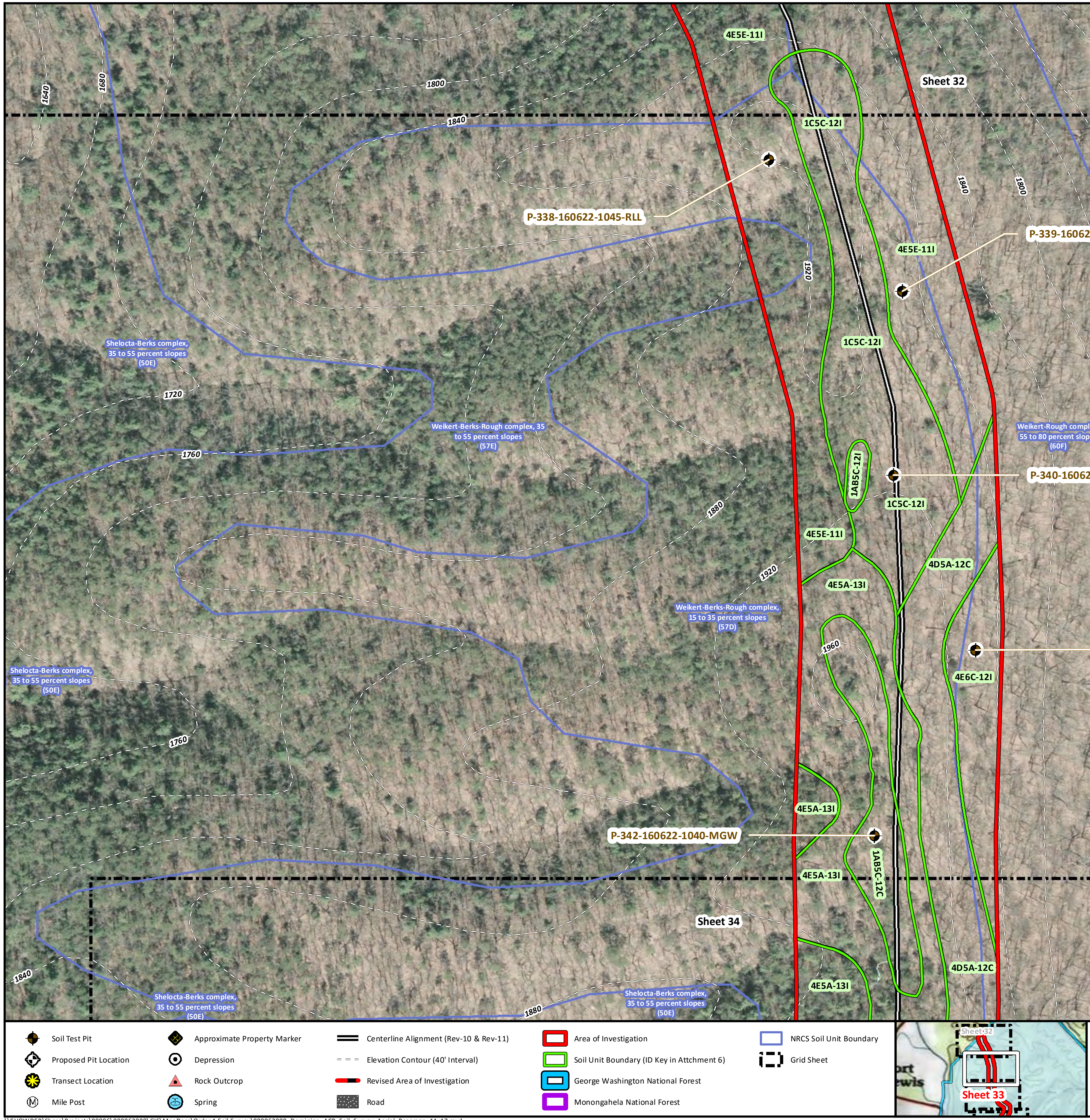

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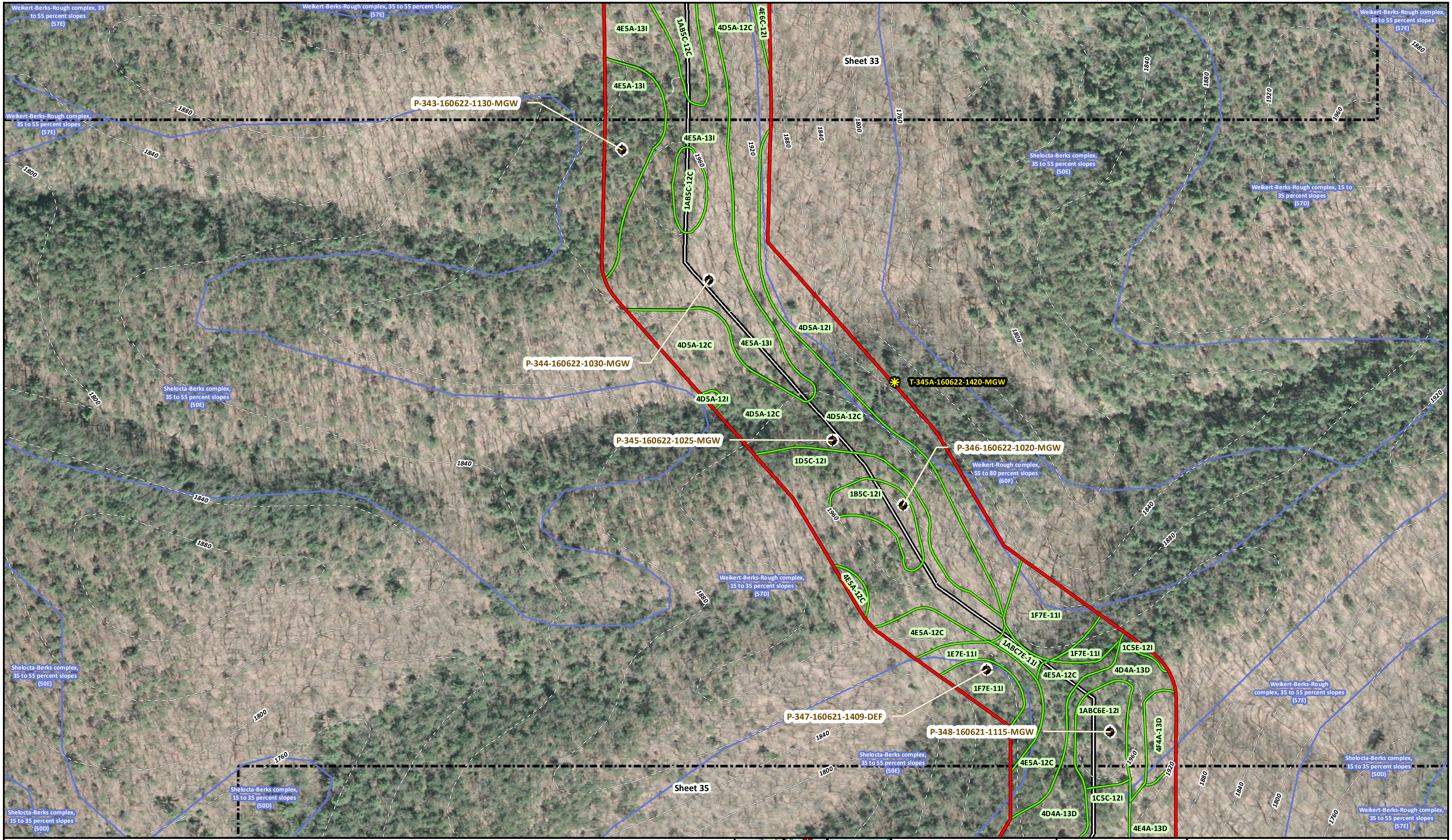

Soil Test Pit
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Transect Location
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0 200 Feet
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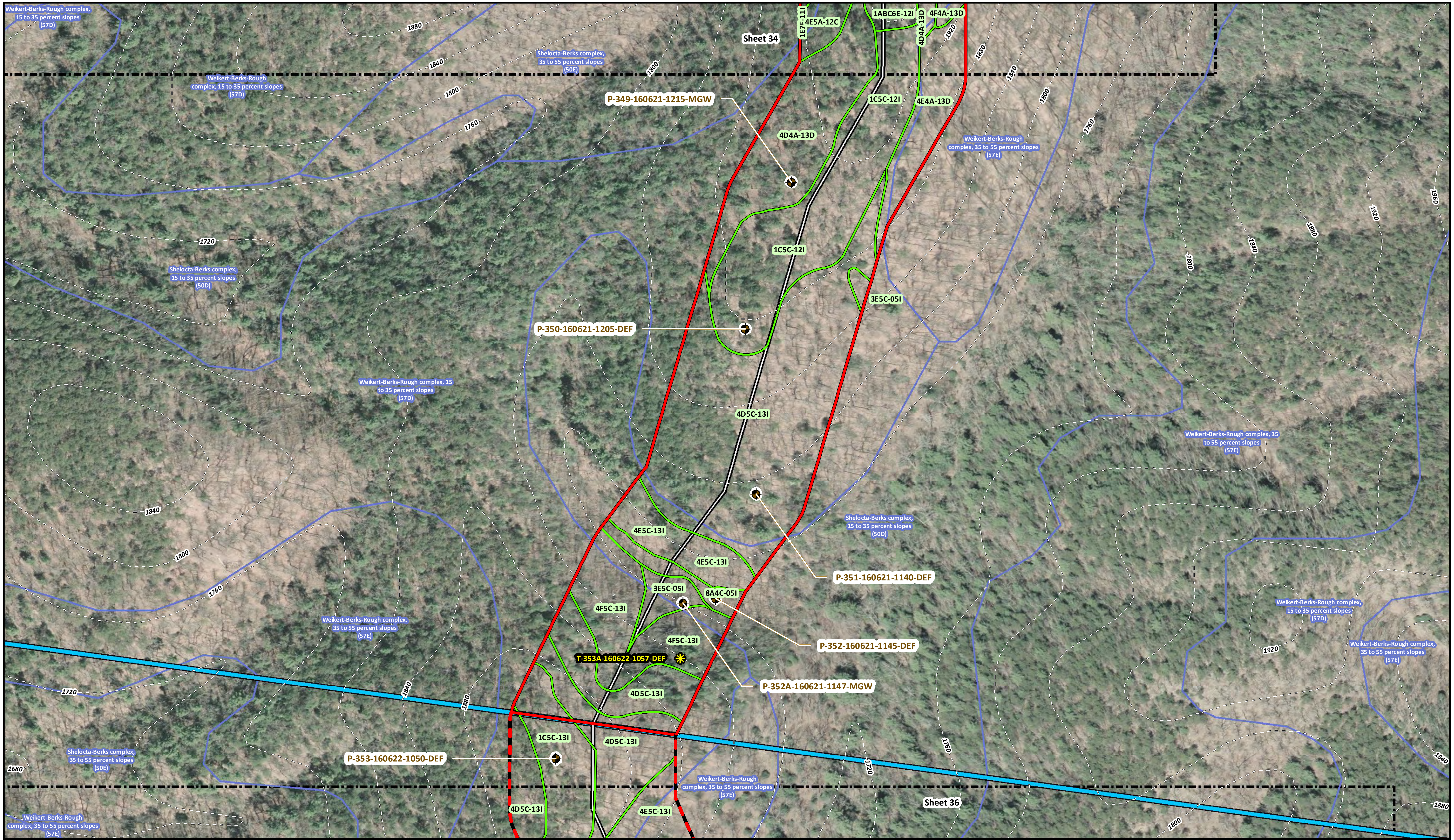

Soil Test Pit
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0 200 Feet

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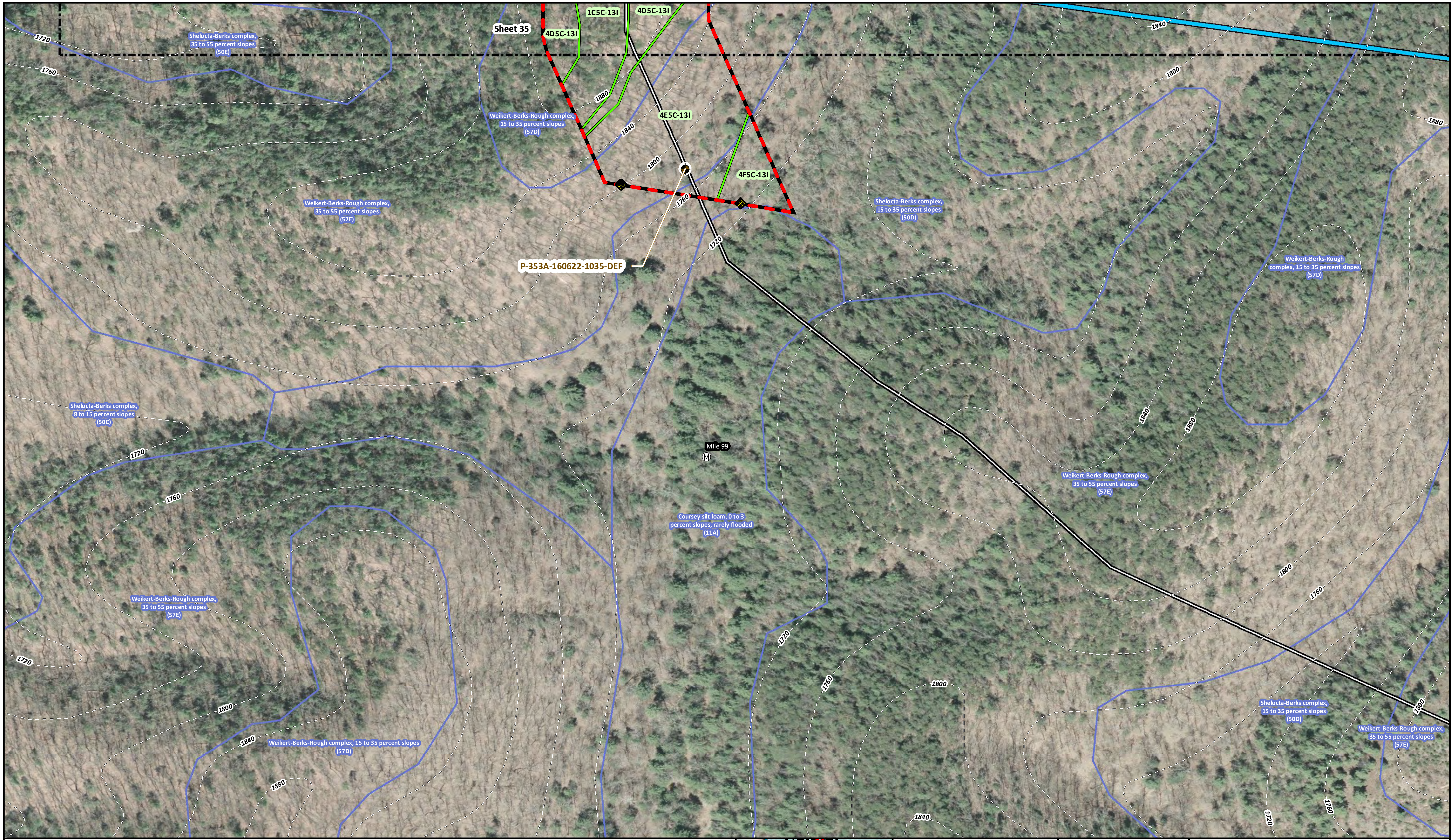

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0 200 Feet
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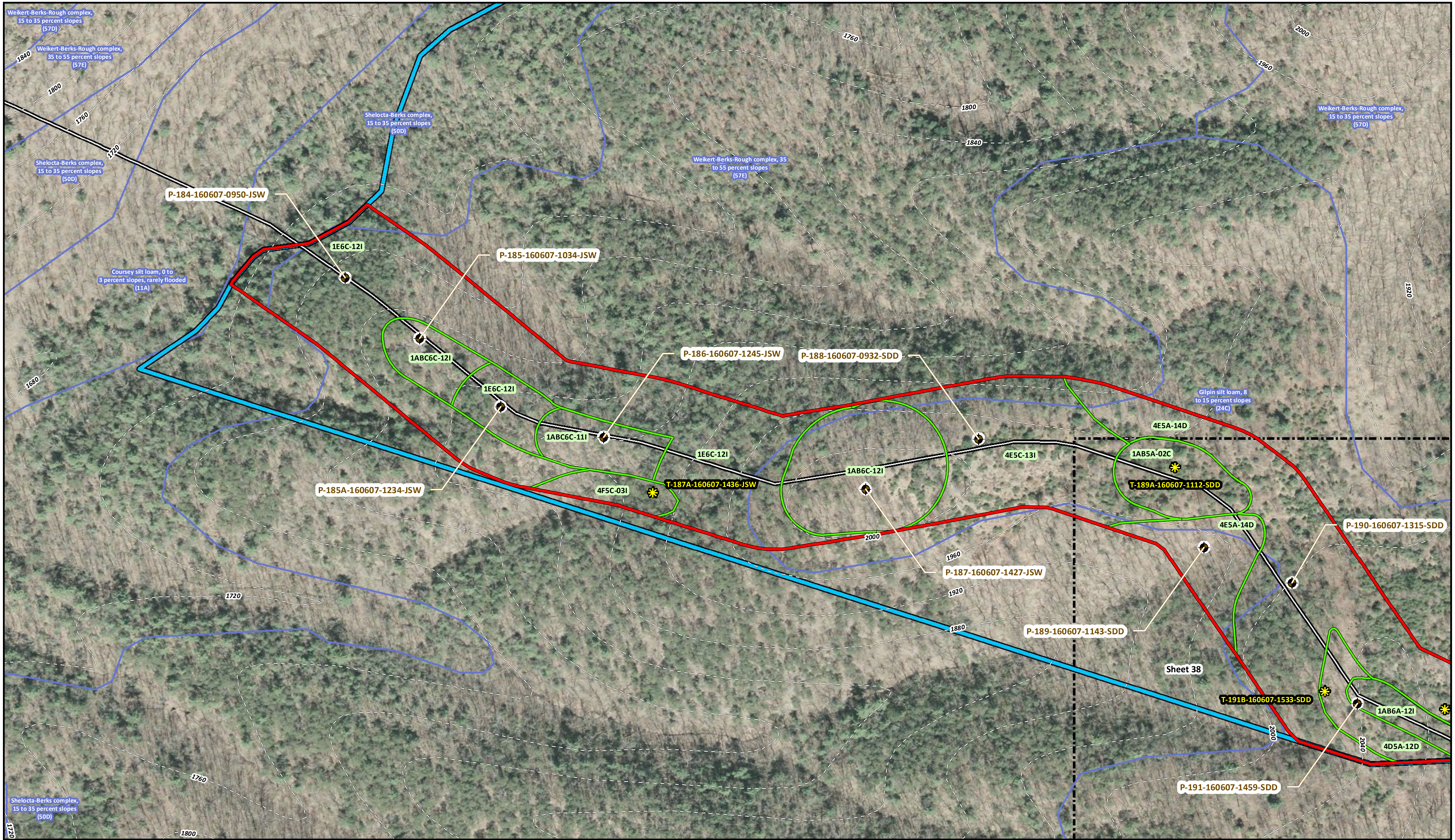

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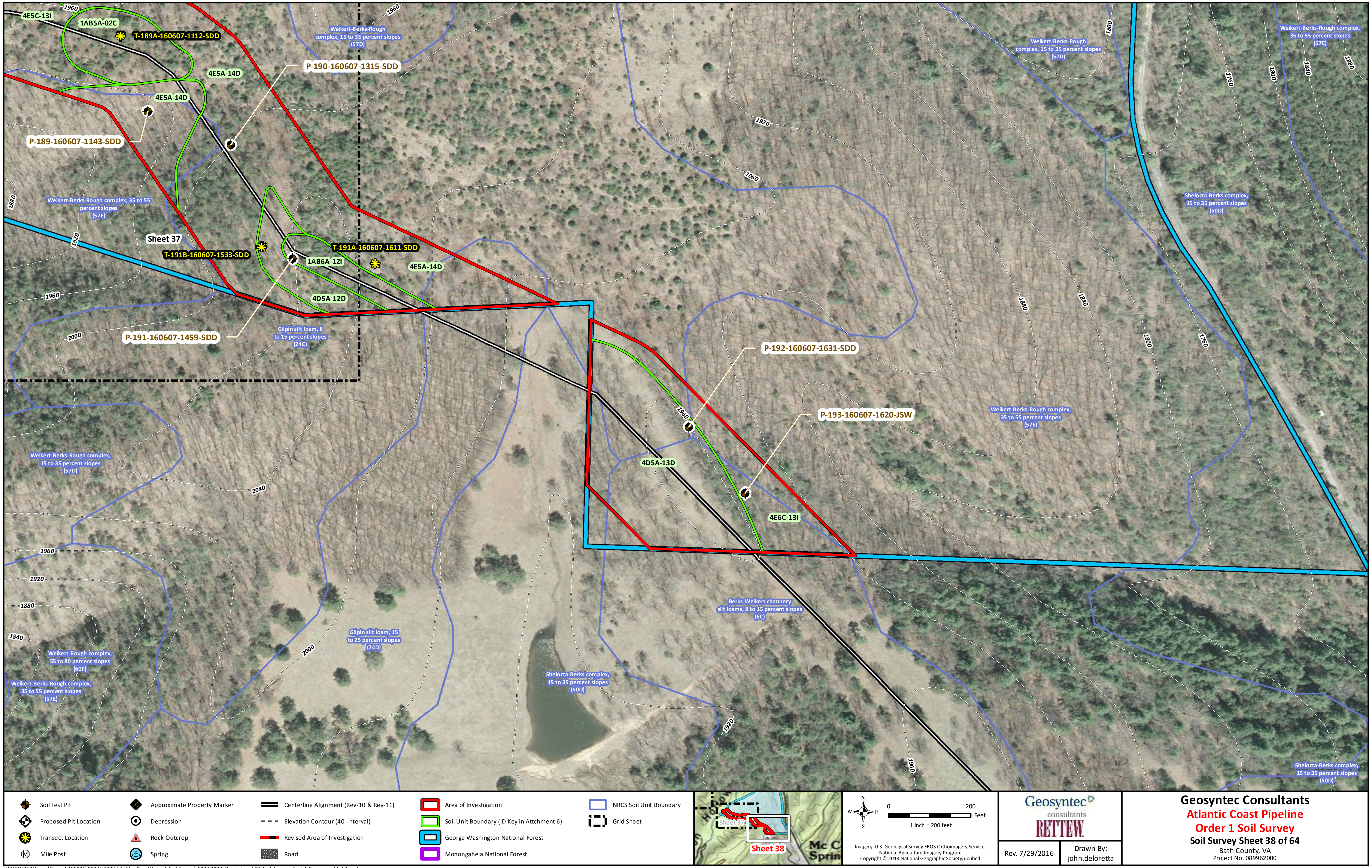

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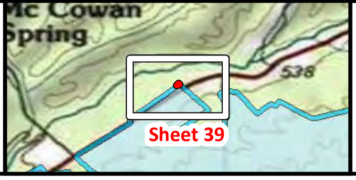

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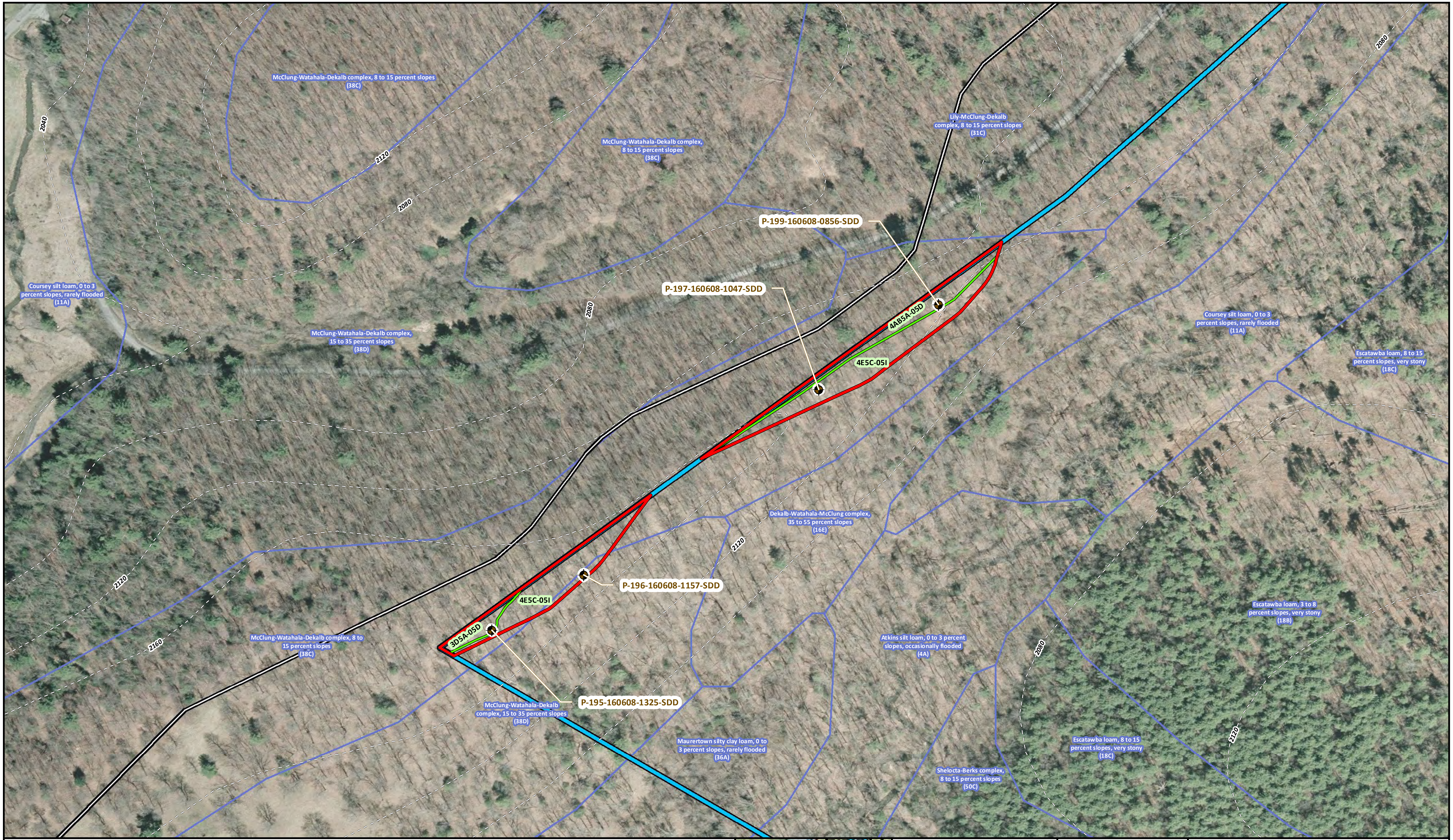

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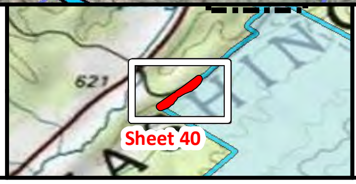

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Bath County, VA
Project No. 089962000

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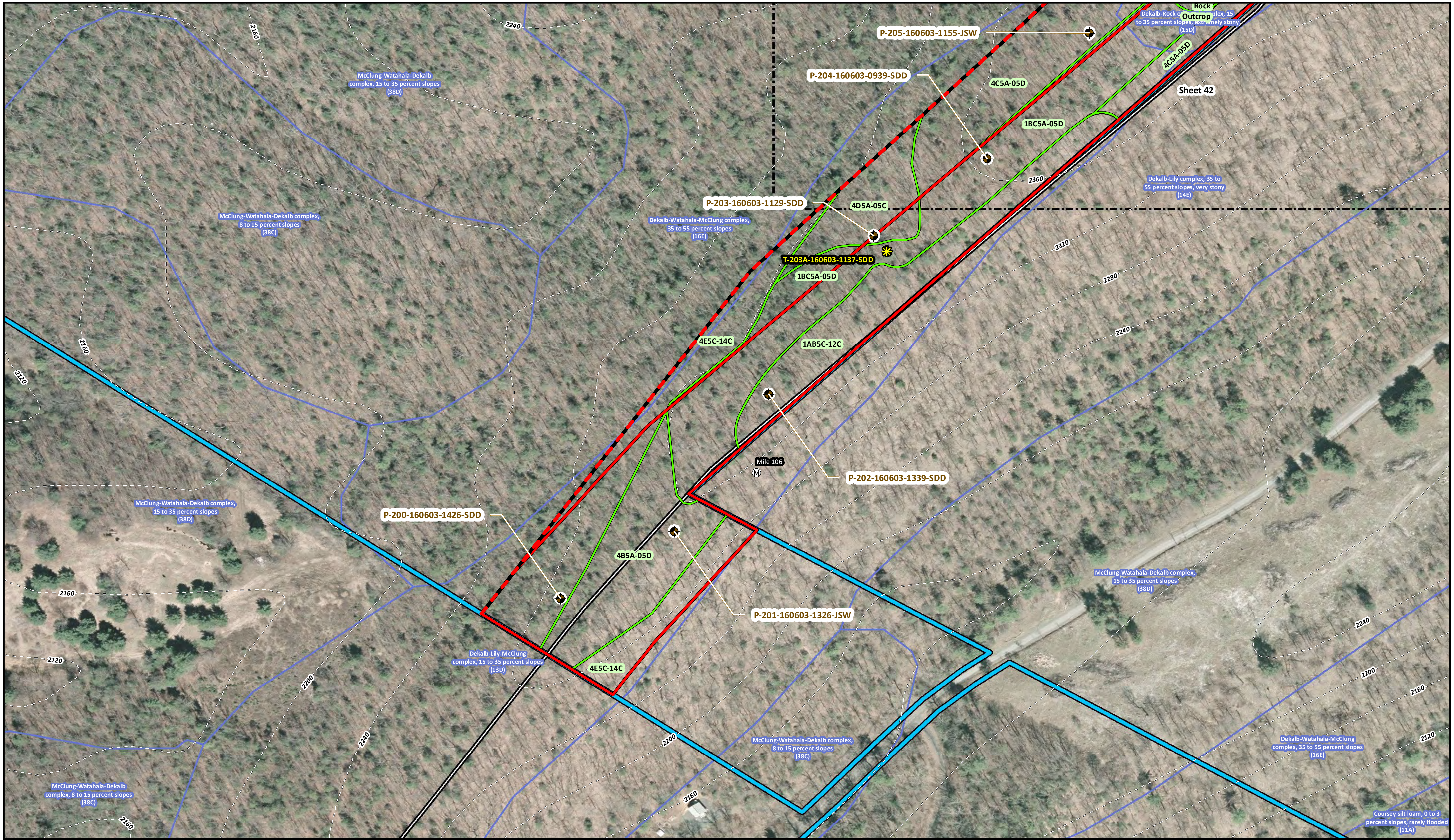
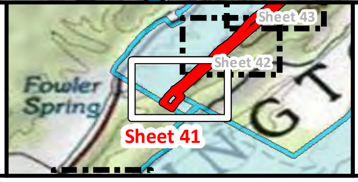


Soil Test Pit
Proposed Pit Location
Transect Location
Mile Post
Approximate Property Marker
Depression
Rock Outcrop
Spring
Centerline Alignment (Rev-10 & Rev-11)
Elevation Contour (40' Interval)
Revised Area of Investigation
Road
Area of Investigation
Soil Unit Boundary (ID Key in Attchment 6)
George Washington National Forest
Monongahela National Forest
NRCS Soil Unit Boundary
Grid Sheet



0 200 Feet
1 inch = 200 feet

Imagery U.S. Geological Survey EROS Orthoimagery Service, National Agriculture Imagery Program
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Geosyntec consultants
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Drawn By: john.deloretta

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Atlantic Coast Pipeline
Order 1 Soil Survey
Soil Survey Sheet 41 of 64
Bath County, VA
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